# MECHANICAL ENGINEERING

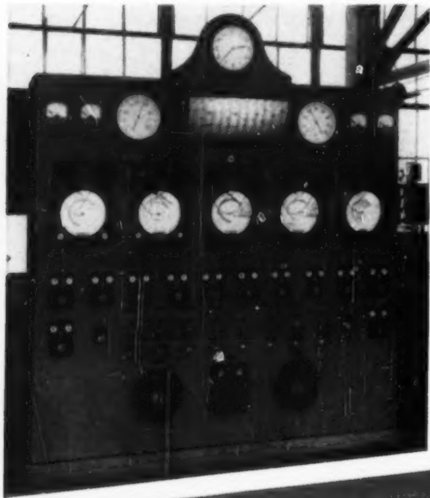
· JANUARY 1952 ·



**Departments**



**ASME SPRING MEETING—Seattle, Wash., March 24-26, 1952**



This Bailey Boiler Control Panel in a mid-western industrial plant saves fuel and insures safe operation of a 100,000 lb per hr, 175 psi, sat., pulverized coal and gas-fired boiler.

# What's Your Control-Dollar Efficiency?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service — conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better control-dollar efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-112-1

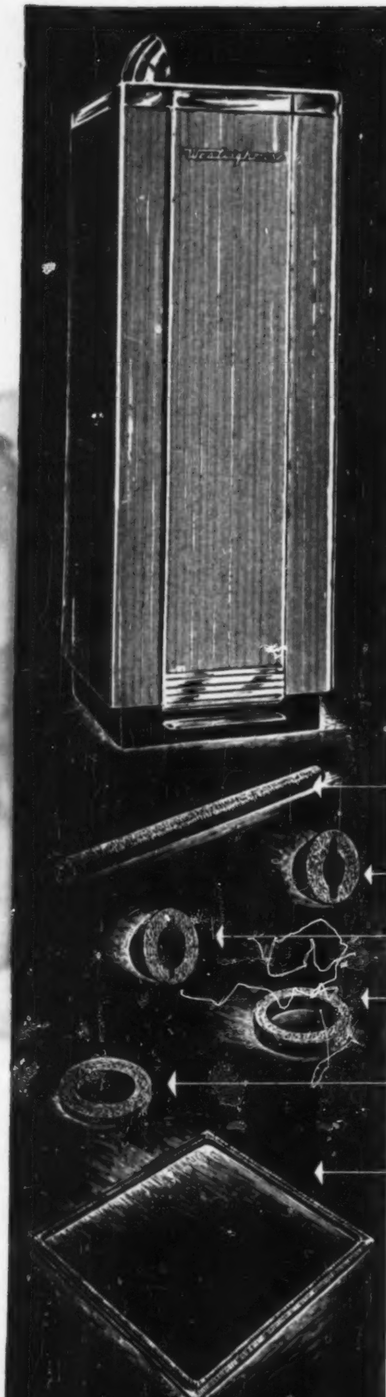
BAILEY METERS

**BAILEY METER COMPANY**

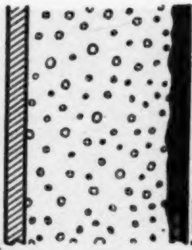
1026 IVANHOE ROAD
CLEVELAND 10, OHIO

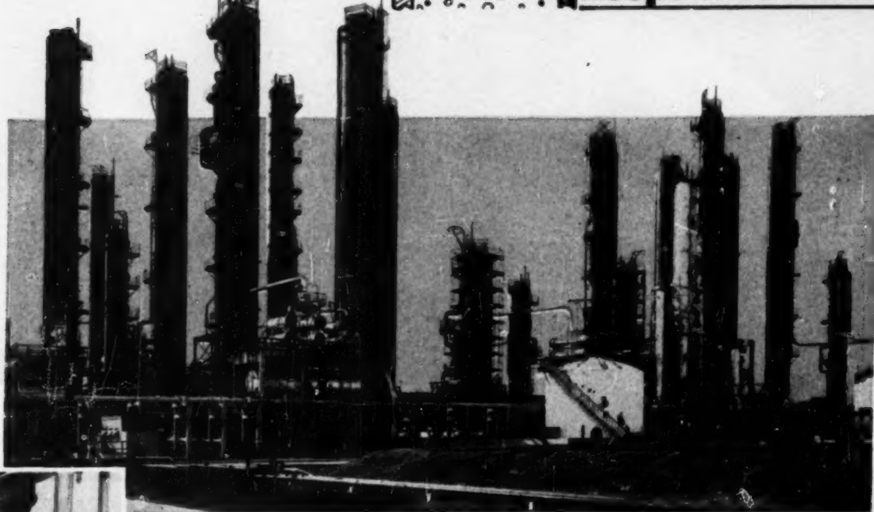
Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS


MECHANICAL ENGINEERING, January, 1952, Vol. 74, No. 1. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢; to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.



# INSUL-MASTIC vapor barrier keeps insulation dry





**Here's what happens when insulation is improperly coated. This became water-soaked. The resultant rust still clings to it.**

Inadequately weatherproofed insulation leads to trouble . . . trouble that can be averted by Insul-Mastic Coatings.

In more and more industrial plants, engineers are replacing their watersoaked insulation . . . using non-absorbent Insul-Mastic Type "D" . . . and in places where more insulation is required, new, dry conventional insulation is being protected with Insul-Mastic vaporseal and glass membrane.

Recently in a large plant the steel shells of huge fractionation towers were very badly rusted and pitted because of water-soaked insulation. An inferior coating over the insulation had permitted moisture and rain to penetrate. To prevent further damage to the shells, the insulation had to be removed.

Where temperatures did not exceed 225° F., Insul-Mastic Type "D", the spray applied cork filled, non-absorbent insulation, was applied. Where temperatures exceeded this figure, standard thermal insulation was applied and sealed with Insul-Mastic vapor-seal and glass membrane.

Engineers are preventing this situation from occurring in their plants by specifying Insul-Mastic high quality, homogenized Coatings, when working out the plans for the insulation and protection of new units and equipment.

There is an Insul-Mastic applicator near you. Write for his name today and check the condition of your insulation now!

*Think first of the coatings that last!*

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## SMALL GEARS Give The Extreme Precision Required For Governors By WOODWARD

Intricate mechanisms like those made by Woodward Governor Company of Rockford operate more accurately and dependably because of G.S. Fractional Horsepower Gearing. These excellent hydraulic Governors are used extensively on stationary diesel engine electric generating units. They have gained an enviable reputation for smooth trouble-free performance.

If *decidedly better* Small Gearing is an important consideration in *your* business, too, check up now on the superior skills and facilities of G.S. Here, eager to serve you, are men, methods and machines developed to the highest known degree of accuracy and efficiency in the speedy, economical mass production of Fractional Horsepower Gearing. Our Small Gear specialists will gladly help you with ideas, suggestions, and cost estimates. Send along your problems or drawings and specifications today!

SEND FOR..


*Free new 6-page folder illustrating and describing G.S. facilities, Small Gearing and applications, together with handy charts. Will you ask for it on company stationery, please?*

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WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF FRACTIONAL HORSEPOWER GEARS

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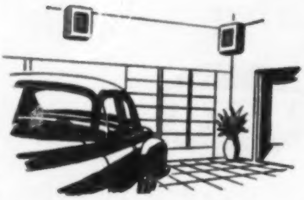
## American Blower... a time-honored name in air handling

Oklahoma City has a conveniently located American Blower Branch Office to provide you with data and equipment for air handling. You can reach American Blower in Oklahoma City by calling 2-0695. In other cities, consult your phone book.

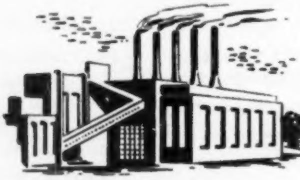


### HEATING LARGE AREAS

Ability to place heat *where* it's wanted and in the *quantity* needed is an advantage that makes American Blower Unit Heaters ideally suited for heating such large areas as warehouses, garages and auditoriums. These dependable unit heaters force heat down to the working level, heat up quickly with little time lag. They are low in first cost, and deliver more heat per pound of material than any other known system of heating. Models available for steam or hot-water heating systems, also self-contained gas-fired models.

### DUST PROBLEM?

If you have a problem along the lines of dust and fly ash collection, American Blower will be glad to help you. We have a wealth of experience in this field that covers not only dust and fly ash removal in industry and public utilities, but also the recovery of valuable materials from air. In addition to local, on-the-spot assistance from our branch office personnel, a modern, fully equipped dust laboratory is maintained in Detroit to serve you.

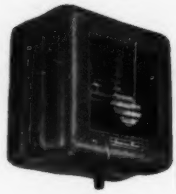


### MORE EFFICIENT POWER

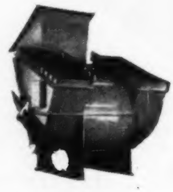
If you're faced with the need of expanding or enlarging power plant facilities, consult American Blower. You'll find our Mechanical Draft Fans help you meet the most exacting power plant requirements. High static efficiency, low RPM, low tip speed and low inlet velocity are but a few of the many reasons these fans have enjoyed such wide acceptance. Types for both forced and induced draft work.

### YOUR BUSINESS

No matter what business you're in, you can count on American Blower heating, cooling, drying, air conditioning or air handling equipment to do the job better, more economically. Phone or write our nearest branch office for data.

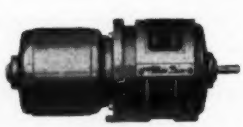


**Unit Heaters**

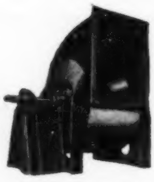


**Mechanical Draft Fans**

**Dust Collectors**



**Gýrol Fluid Drives**



**Industrial Fans**

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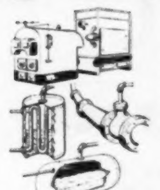
## You're ahead 4 ways when you

# SELECT SERVEL

## AIR CONDITIONING EQUIPMENT

**EXCLUSIVE ADVANTAGES OF SERVEL "ALL-YEAR" AIR CONDITIONING MAKE IT YOUR BEST BUY FOR TODAY—AND FOR THE YEARS AHEAD!**

### 1 Use existing steam lines to operate your Servel at low cost!

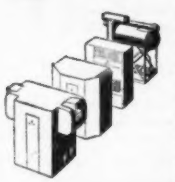


Servel air conditioning units can be connected to your present source of steam to give you air conditioning at nominal cost. Servel "All-Year" Air Conditioners also operate on gas, oil, LP gas, waste heat, or steam from any source, at any pressure. With this multiplicity of fuels, Servel lets you use the most economical energy source.

### 3 Servel "no moving parts" design cuts maintenance costs!

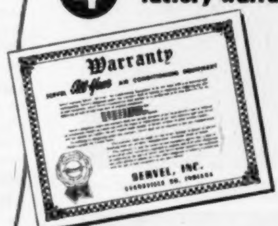

Operating on the famous absorption principle, Servel units deliver quiet, continuous, vibrationless operation at peak performance . . . year after year . . . and, because there is nothing in their cooling systems to wear out, require a minimum of maintenance! Operating within a vacuum—they are absolutely safe.

### 2 Servel has the model to do your job better!



Do you have a problem in your plant that could be solved by the use of chilled water in one of your processes? Servel has the unit to remedy it! What do you want to air condition . . . a factory space, a store, an office? Servel has the unit or combination of units to provide economical air conditioning how and where you want it! You may have cooling only . . . a year 'round combination of heating and cooling . . . or combination units for vibration-free multiple floor air conditioning.

### 4 Servel has a five year factory warranty!




Servel's refrigeration unit is warranted for five full years! Five times as long as all other comparable air conditioning units.

SELECT SERVEL . . . the air conditioning that offers low operating costs, proven dependability, quiet, vibrationless operation—and an exclusive 5-year warranty!


SELECT SERVEL . . . the air conditioning that offers low operating costs, guaranteed dependability in home, commercial or industrial installations.

**Servel**

**AIR CONDITIONING**

*Made by the makers of the famous Servel Refrigerator*

SERVEL, INC. • Evansville 20, Indiana

***Write for the amazing cost-cutting facts about Servel Air Conditioning today!***

**Servel, Inc., Dept. ME-1, Evansville 20, Indiana**

Gentlemen:

I'm interested in more information on Servel's new, low cost air conditioning. Rush me details on ( ) Industrial ( ) Commercial Air Conditioning.

*Name* ____________________

*Firm* ____________________

*Address* ____________________

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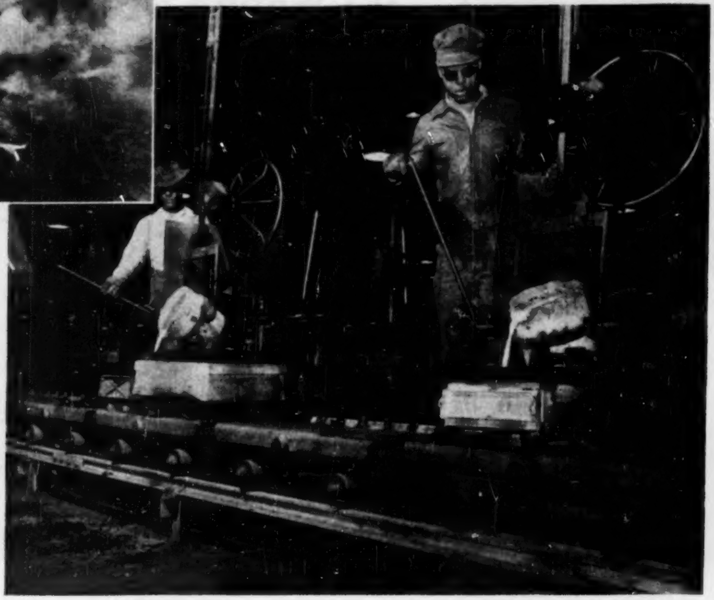
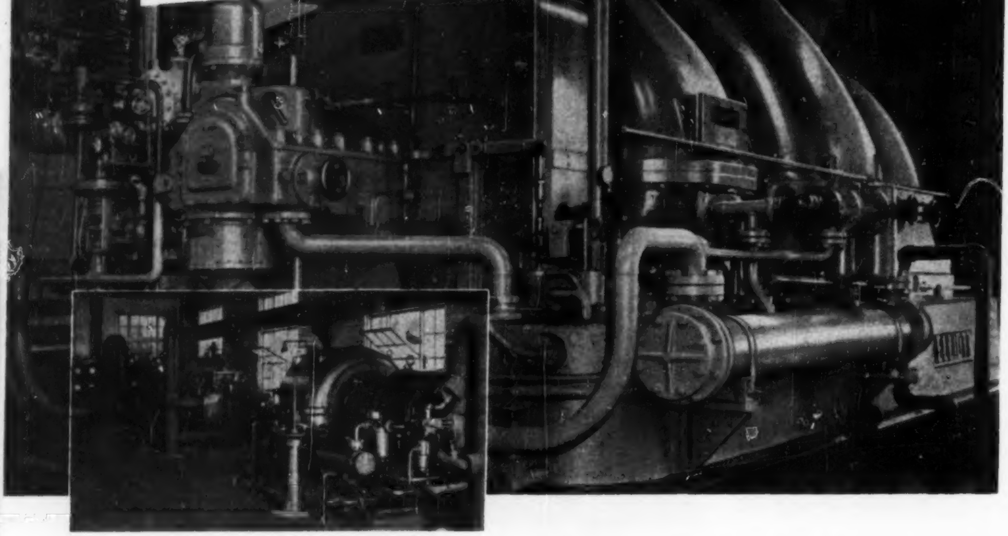


# For Shattering a World's Record or Serving the World's Largest Pipe Mill



# ...Elliott turbine-driven blowers depend on Ross Exchangers for lube oil temperature safety

In fluid cat cracker service at a mid-western refinery, a 3500 hp Elliott multi-valve condensing steam turbine driving an Elliott multi-stage blower, with a capacity of 50,000 cfm of free air, has shattered a world's record by piling up 677 days of continuous operation. A Ross Exchanger has the job of protecting the lubricating oil temperature.

At the world's largest pipe mill in Ohio, four 600 hp Elliott multi-stage steam turbines (inset photo) are driving four Elliott multi-stage blowers rated at 29,750 cfm each. These, also, have the protection of Ross Exchangers.

Just as Ross Exchangers are doing a job for Elliott in these and other important instances, so can they become key accessories on *your* turbines, compressors, engines and hydraulic machines . . . no matter what field they're serving.

You'll find more Ross Exchangers as built-in components than any other make. Ross standardization has accomplished this.

Literature describing these units will be mailed promptly at your request. Ross Heater & Mfg. Co., Inc., Division of American Radiator & Standard Sanitary Corp., 1398 West Avenue, Buffalo 13, N. Y. In Canada, Horton Steel Works, Limited, Fort Erie, Ont.


*Serving home and industry*

# G-E Adjustable-speed Drive Increases Ozalid Machines' Versatility, Accuracy

**Reproduction machine's speed easily set for various kinds of paper, with electronic Thy-mo-trol* drive**

Reproducing "short-order" copies of virtually any kind of printed matter, drawings, etc. is the function of Ozalid's new Ozamatic machine. One secret of the versatility of this and all other Ozalid machines is G-E Thy-mo-trol drive.

Speed of the machine must be matched to the type, weight, and thickness of paper being used in each copying job. The simplicity of the Thy-mo-trol drive permits the operator to make the proper speed adjustment quickly and accurately simply by turning the speed-control knob. Thus, the machine can handle a great variety of copy jobs quickly, and with little training required for the operator.

The electronic precision of Thy-mo-trol, one of G.E.'s adjustable-speed family, has helped many equipment manufacturers improve the performance of their machines by greatly increasing their versatility and accuracy. And G-E adjustable-speed drives are helping manufacturers in every field to increase production with improved quality control, saving scarce materials, cutting rejects, and making existing machinery more flexible. One or more of this versatile drive family can probably do the same for you. Best way to find out is to mail the coupon below.

**ON THE OZAMATIC,** Ozalid's new desk-top machine, the operator quickly and accurately selects the desired speed—from 0 to 30 feet per minute—simply by turning the speed-control knob. Electronic Thy-mo-trol drive—standard equipment on all Ozalid machines who pioneered its use on reproduction machines—does the rest.

## WHICH DRIVES ARE BEST FOR YOU?


**This 26-page manual will help you decide.** It shows you how to go about selecting the *right* drive. The handy drive chart included is worth your detailed study. Bulletin GEA-5334. Check here........ ☐

**General Electric Company, Section 646-17**
**Schenectady 5, N. Y.**

**Please send me the bulletins checked:**

☐ for reference only

☐ for planning an immediate project

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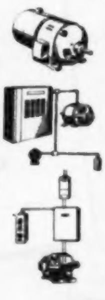

**THE ACA MOTOR**—*Speed ranges to 20:1*—An adjustable-speed a-c motor. Speed range 3:1 or 4:1 continuous; for intermittent operation from 6:1 to 20:1. Bulletin GEA-4883. Check here.............................. ☐

**THE SPEED VARIATOR**—*Speed ranges to 40:1*—An adjustable-voltage d-c drive that uses a-c power. Speed ranges 8:1 to 40:1 and beyond. Bulletin GEA-5335. Check here.......... ☐

**THY-MO-TROL***—*Speed ranges to 100:1*—The most accurate, most versatile, and fastest acting of all G-E adjustable-speed drives. Speed ranges of 100:1 or better. Bulletin GEA-5337. Check here........................ ☐

**ELECTRONIC SPEED VARIATOR**—An electronically controlled version of the Speed Variator that offers most of the features of Thy-mo-trol for applications in the 15 to 60-hp range at moderate cost. Bulletin GEA-5336. Check here................ ☐

* *Thy-mo-trol is the General Electric Company's registered trade-mark for its electronic motor-control system.*

*Headquarters for* ELECTRICAL ADJUSTABLE-SPEED DRIVES

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in the great Spring Using Area of America . . .
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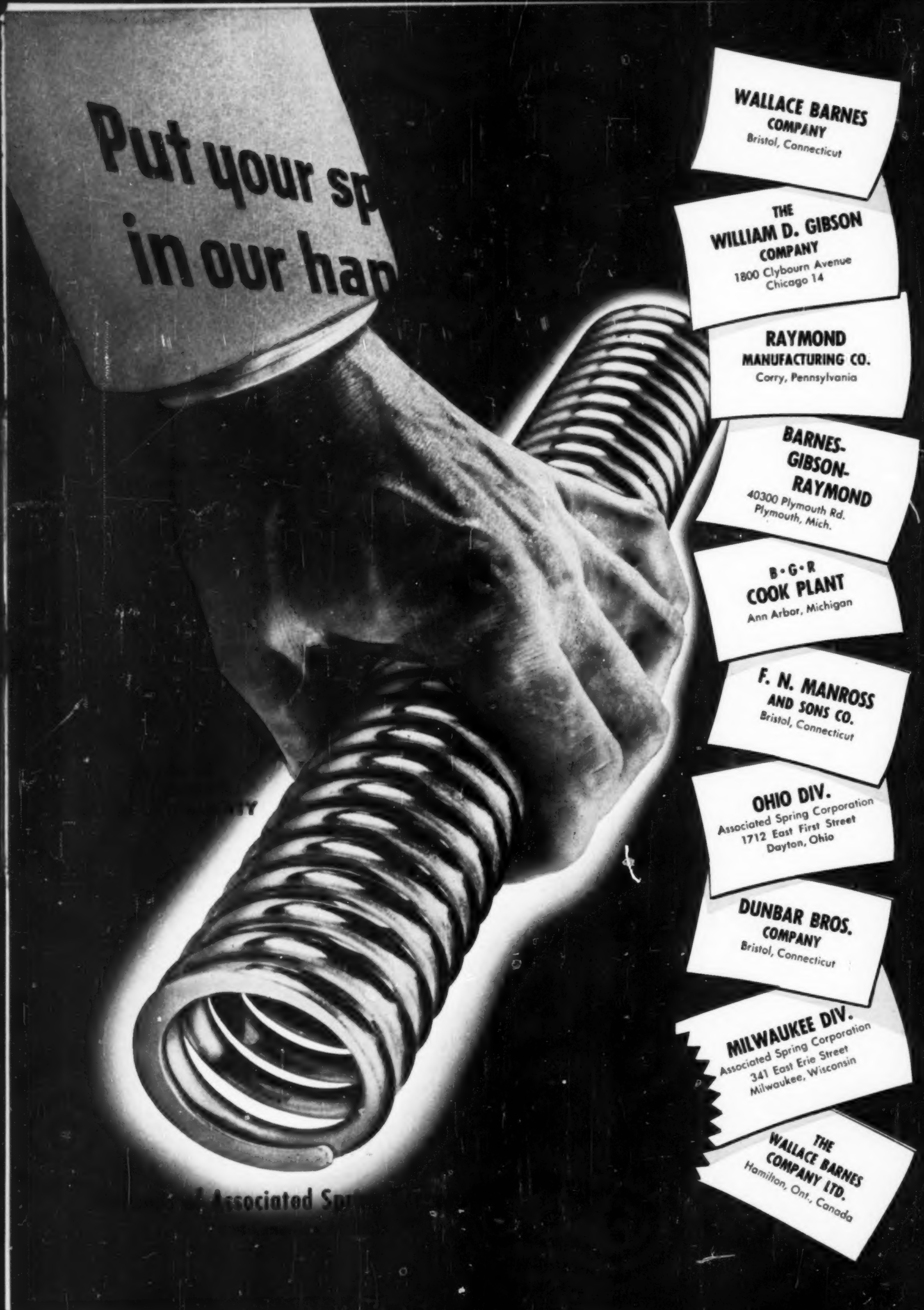
DUNBAR BROTHERS COMPANY BRISTOL, CONN.
MILWAUKEE DIVISION 341 E. ERIE ST. MILWAUKEE, WIS.
THE WALLACE BARNES COMPANY LTD. HAMILTON, ONT. CANADA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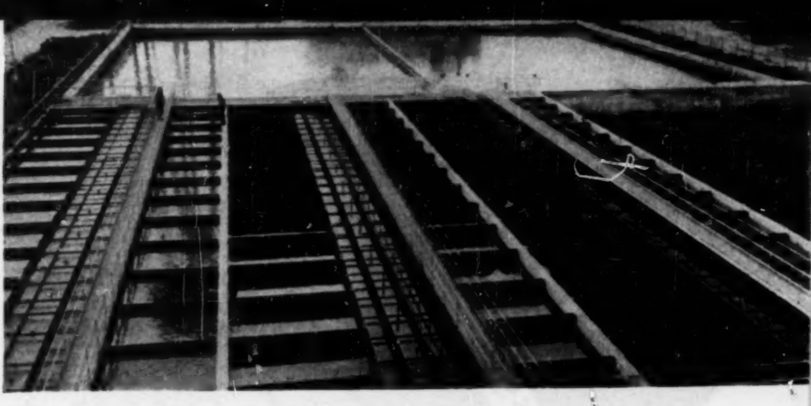


Three Permutit Precipitators at Alcoa's Davenport, Iowa plant. Each processes 3,000,000 gallons of water a day.

# How Permutit helps Alcoa get BETTER WATER...

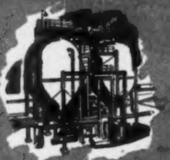
**with**
**LOW TURBIDITY**
**LOW OPERATING COST**
**LOW CHEMICAL COST**
**LOW WATER WASTE**

Alcoa's water needs average 9,000,000 gallons per day in their Davenport, Iowa plant. A Permutit Precipitator processes all their mill use water, and yields an effluent turbidity of only 5 ppm from an influent turbidity as high as 900 ppm. Yet operating cost, including pumping, chemicals, depreciation and maintenance, is only 5¢ per thousand gallons. Of this, chemical cost is less than 2¢ per thousand. Water waste has averaged only 8.75%.

Precipitators for lowering alkalinity and removing turbidity of water are only one of many Permutit products for solving water conditioning problems. In the column at left, some of the more important basic processes are illustrated and described.

Find out how Permutit can solve *your* water processing problems. Write to The Permutit Company, Dept. ME-1, 330 West 42nd Street, New York 36, N. Y., or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance St., Montreal.

## THESE BASIC PROCESSES, PLUS PERMUTIT SKILL, CAN SOLVE YOUR WATER CONDITIONING PROBLEMS

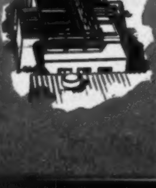


**1. SLUDGE BLANKET HOT LIME SODA.** Application of the sludge blanket to hot lime soda treatment reduces silica in boiler feed make-up, produces high quality steam.

**2. HOT ZEOLITE—PERMUTIT Q.** Subsequent treatment of water from hot lime soda treatment yields effluent of zero hardness. Permutit Q, or styrene base mineral resistant to high temperatures, replaces second stage phosphate treatment.

**3. SILICA REMOVAL PLUS DEMINERALIZATION.** Demineralization by cold ion exchange processes produces water comparable to distilled water only at a fraction of the cost of distillation. Treatment by anion exchange resin, Permutit S, reduces silica to less than 0.2 ppm.

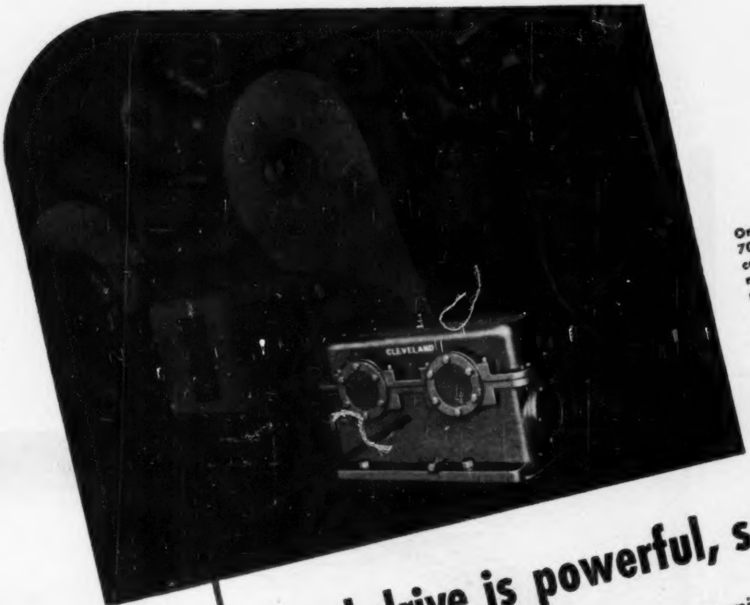
**4. DEAERATING HEATER.** The Permutit Deaerating Heater, utilizing exhaust or bled steam, prevents corrosion of feed lines, stage heaters, economizers, and boilers, by removing oxygen and free $CO_2$. Capacities from 12,000 to 1,400,000 pounds per hour are in service.



**5. PRECIPITATOR.** The Permutit Precipitator is used to lower alkalinity, reduce hardness, and help to remove turbidity, color, taste and odor. It can also be used to reduce silica.

**PERMUTIT®**

WATER CONDITIONING HEADQUARTERS FOR OVER 38 YEARS




One of three Cleveland special 70AT units driving a woolen card at one of the large textile mills in New Hampshire. The unit pictured drives the main card cylinder, stripper rolls and the fancy roll. There are powerful, right-angle Cleveland drives for every type of service.

# Compact Cleveland drive is powerful, sure and safe

● Adequate aisle space is essential in a woolen mill—so units that drive woolen cards must be compact, yet powerful enough to do the job. That's why the Davis and Furber Machine Company of North Andover, Massachusetts, has made Cleveland Worm Gear Speed Reducers standard equipment on its new Model L carding machine.

In addition to allowing needed space between cards, Cleveland drives mean safer working conditions. Large diameter pulleys and flat belting, once a serious safety hazard, are eliminated.

Cleveland is first choice for any job where a powerful, trouble-free, right-angle drive is desired. Engineers know from experience that they can depend on Clevelands, wherever they serve. They give satisfactory service, no matter how severe the conditions.

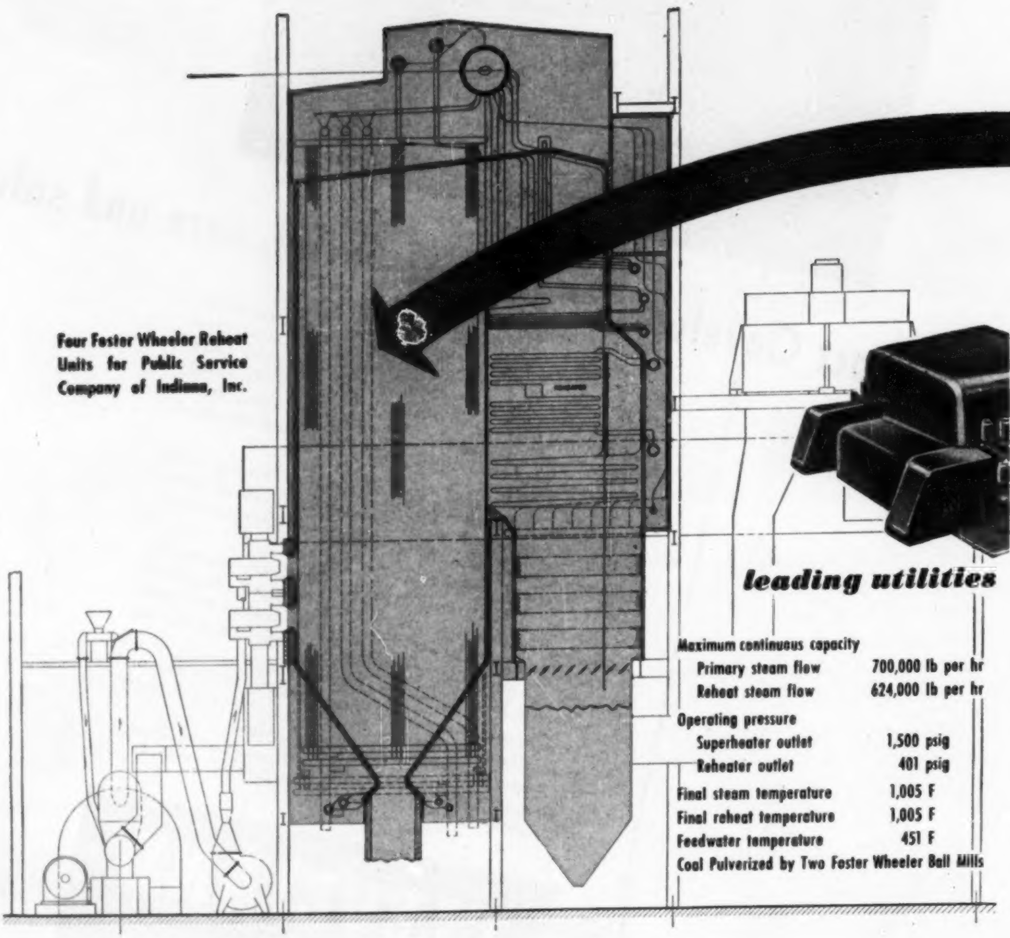
For specifications and other details, write for our current catalog. The Cleveland Worm & Gear Company, 3264 East 80th Street, Cleveland 4, Ohio.

*Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.*

**CLEVELAND**

*Speed Reducers*

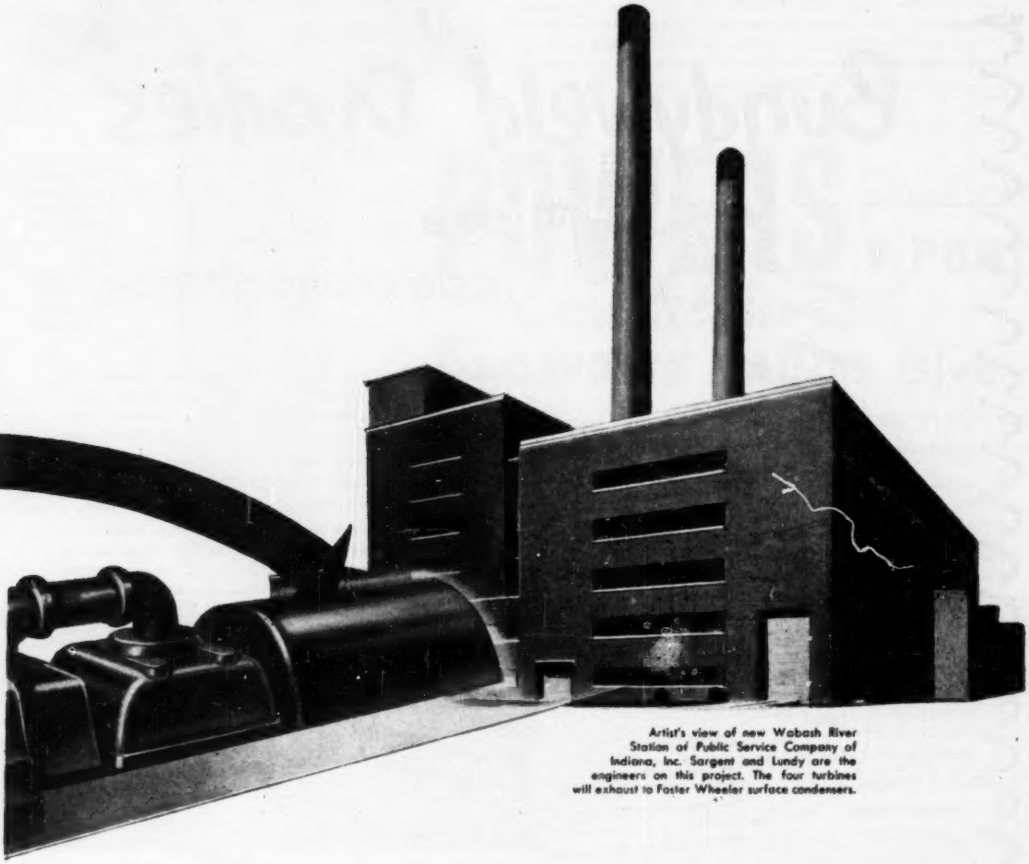
# *Integrating*



Four Foster Wheeler Reheat Units for Public Service Company of Indiana, Inc.

***leading utilities***

| | |
|---|---|
| **Maximum continuous capacity** | |
| Primary steam flow | 700,000 lb per hr |
| Reheat steam flow | 624,000 lb per hr |
| **Operating pressure** | |
| Superheater outlet | 1,500 psig |
| Reheater outlet | 401 psig |
| Final steam temperature | 1,005 F |
| Final reheat temperature | 1,005 F |
| Feedwater temperature | 451 F |
| Coal Pulverized by Two Foster Wheeler Ball Mills | |



Artist's view of new Wabash River Station of Public Service Company of Indiana, Inc. Sargent and Lundy are the engineers on this project. The four turbines will exhaust to Foster Wheeler surface condensers.

## *are ordering Foster Wheeler reheat steam generators*

The large investment in present day power plant equipment dictates the careful selection of major components so as to avoid costly forced outages. Foster Wheeler engineers have always sought to refine the techniques of steam generation. They therefore took an early interest in the development of reheat where operating and control characteristics of the reheat boiler are integrated with those of the reheat turbine during every phase of service. Almost three decades ago, these engineers were responsible for the utilization of the characteristics of radiant and convection superheaters in series. Over "500 radiant superheater years" in one utility alone attest to the reliability of radiant surface for superheating.

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This design also incorporates such features as:

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These features provide for complete integrating of steam generating unit with turbine requirements under normal, quick start or emergency conditions.

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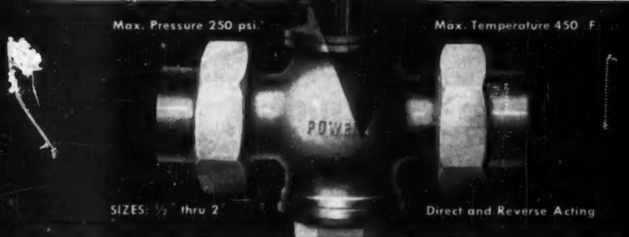


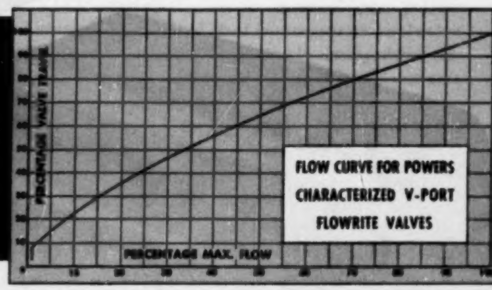


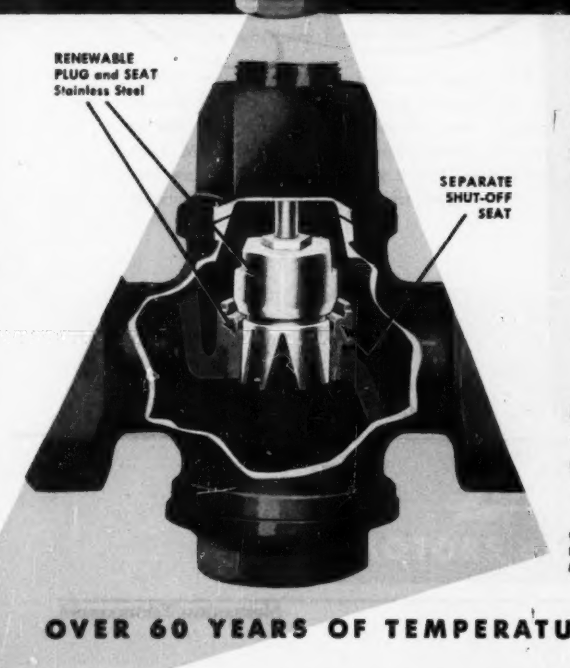


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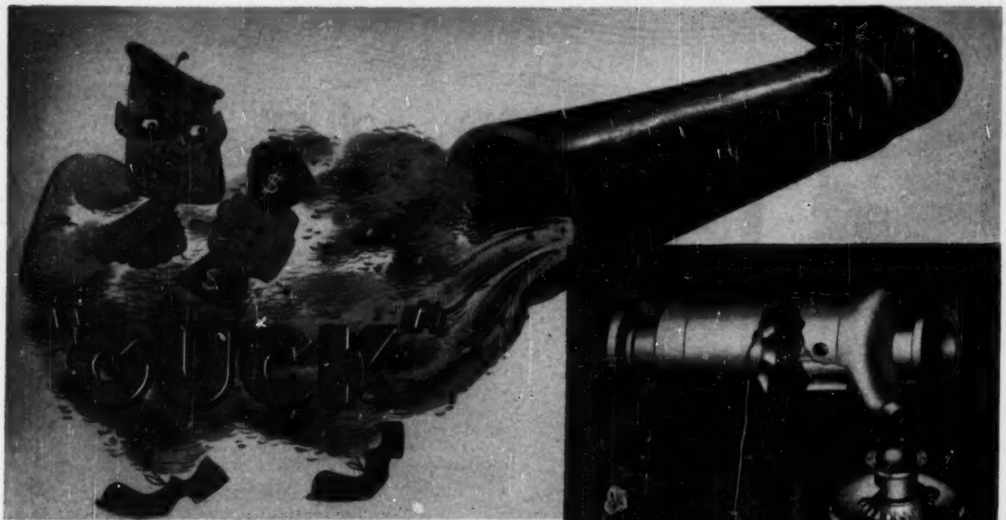


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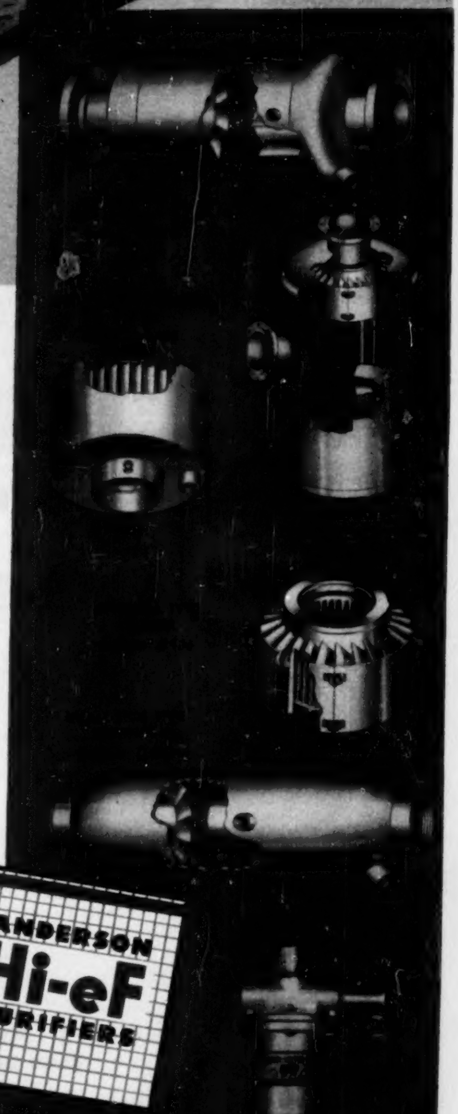


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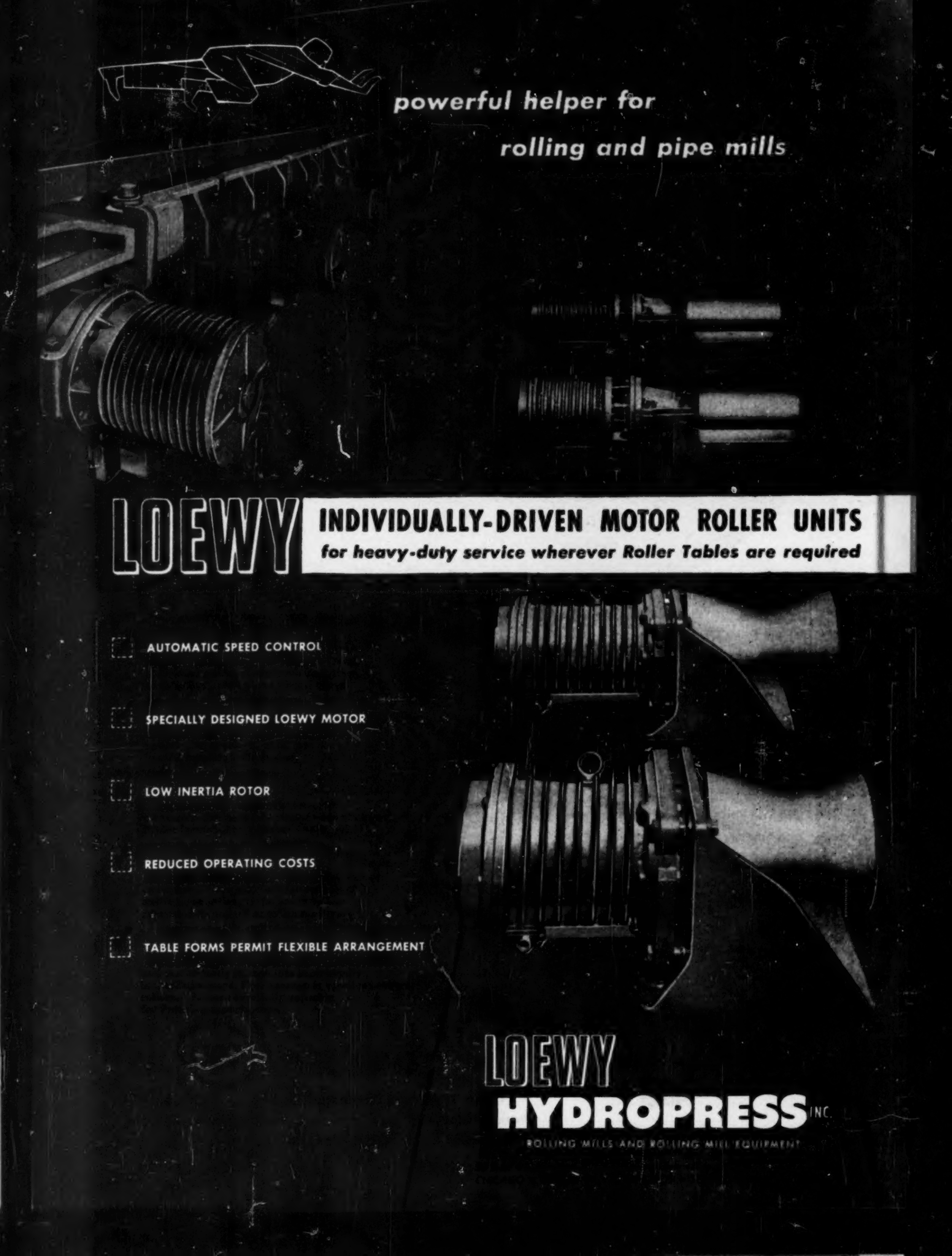
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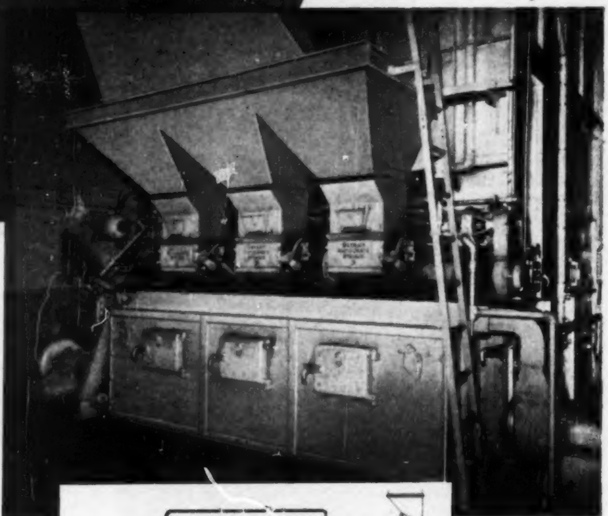
*Detroit RotoGrate Stoker with Erie City Type VL Boiler at Certain-teed Products Corporation, York, Pa. Capacity 45,000 pounds steam per hour. Operates with preheated air.*



THIS Detroit RotoGrate Stoker fired unit has reduced fuel cost 12.6c per thousand pounds of steam at Certain-teed Products Corporation plant at York, Penna., according to report by Mr. W. M. Noon, Combustion Engineer. The reduction in steam cost was made at the same time plant capacity was increased.

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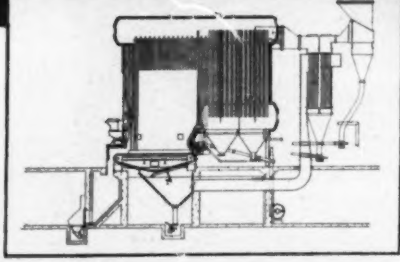

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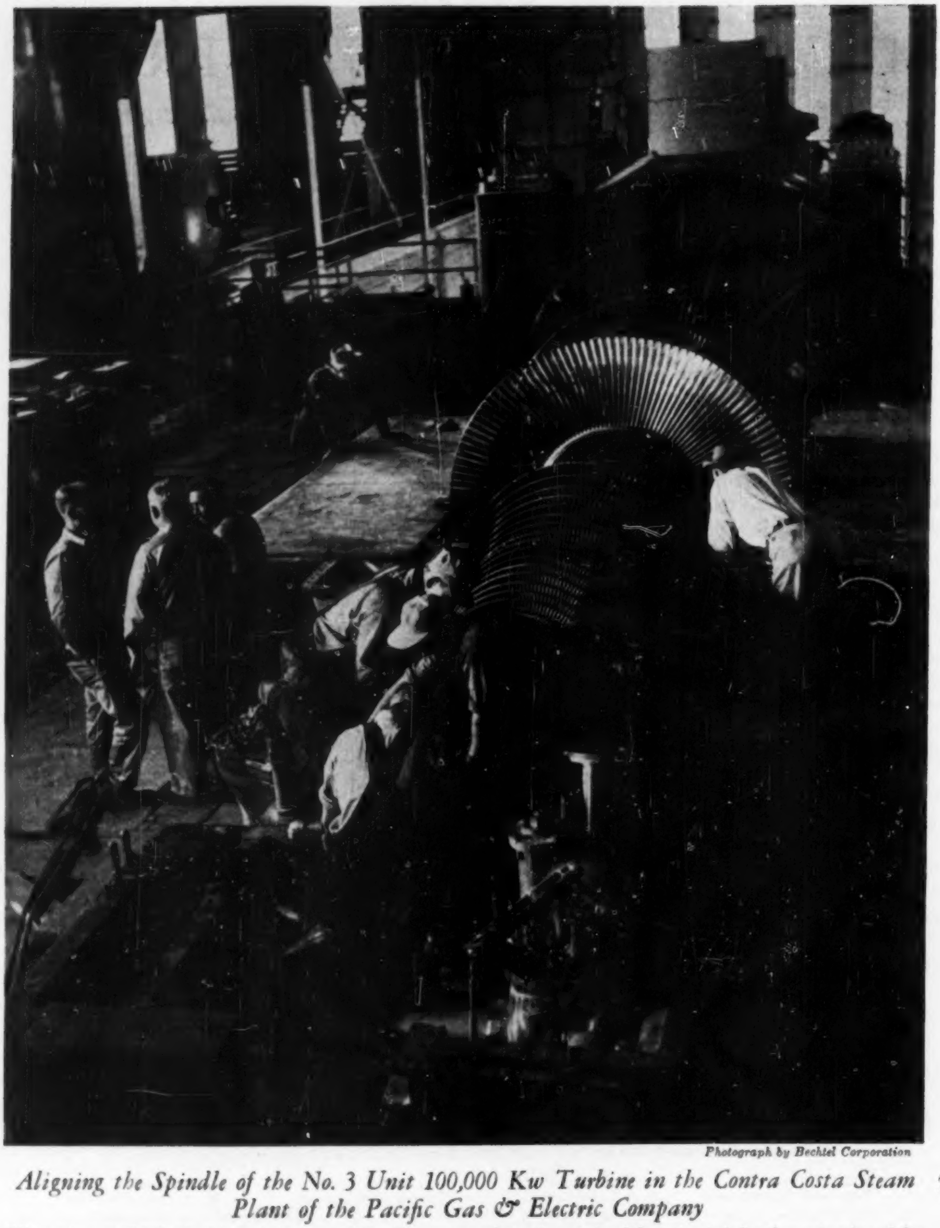

Photograph by Bechtel Corporation

*Aligning the Spindle of the No. 3 Unit 100,000 Kw Turbine in the Contra Costa Steam Plant of the Pacific Gas & Electric Company*

*(This station was officially placed in service in August, 1951. The gross normal operating capacity of the station, including three main units and three house units, is 340,000 kw. The turbine generators are by the General Electric Company. The entire plant was designed and constructed by the Bechtel Corporation of San Francisco in collaboration with the Pacific Gas & Electric Company's engineering and purchasing departments.)*

# *Less Familiar* METALS *of* COMMERCIAL IMPORTANCE

By ROBERT A. LUBKER

ASSOCIATE CHAIRMAN, METALS RESEARCH, ARMOUR RESEARCH FOUNDATION, CHICAGO, ILL.

INTRODUCTION

WHILE the prominent function of such metallic elements as iron, aluminum, copper, lead, nickel, magnesium, tin, and zinc is well known, the properties of many other metals used commercially and the reason for their usage are not generally common knowledge. Although many of them are used only as alloying additives, nevertheless they are essential in giving such alloys the desired characteristics. This paper will discuss the availability, production processes, properties, alloys, cost, and uses of twenty metals which are relatively uncommon but of appreciable or potential industrial importance. The periodic order of these metals is given in Table 1.

TABLE 1 PERIODIC ORDER OF LESSER-KNOWN METALS

| Group I | Group II | Group III | Group IV | Group V | Group VI | Group VII |
|---|---|---|---|---|---|---|
| Lithium | Beryllium | Boron | Germanium | Vanadium | Molybdenum | Rhenium |
| Sodium | Calcium | Gallium | Titanium | Columbium | Tungsten | |
| | | Indium | Zirconium | Tantalum | Selenium | |
| | | Thallium | Hafnium | | Tellurium | |

This information should be of considerable interest to mechanical engineers confronted with problems where the more common metals will not serve to complete satisfaction.

LITHIUM

Lithium is the lightest of all metals, having only one half the density of water. In 1947 the metal was quoted at $10.50 per lb, the high cost being due to a complicated production process on a small scale. Generally, the metal is made by electrolysis of the chloride, although silicon reduction of the oxide in the presence of calcium oxide is an alternative production method of potential technical application.

Use of the metal is limited because of its reactivity with water and oxygen. For the very same characteristic, however, it is employed as a scavenger in liquid metals, as a "getter" in vacuum tubes, and as a component in protective furnace atmospheres where it is effective in preventing scaling and decarburization. It melts at 185 ± 5 C and boils at 1370 C. Lithium is used to a slight extent as an alloying element in lead, copper, aluminum, and magnesium. It is a constituent of the German "Bahn" metal, a lead-base bearing alloy which remains hard at comparatively high temperatures and contains 0.69 per cent calcium, 0.62 per cent sodium, and 0.04 per cent lithium.

During the war, lithium hydride and lithium borohydride, both made from lithium metal, were important portable sources of hydrogen for aeronautical purposes. Lithium peroxide was used as a source of oxygen and as an absorbent for carbon-dioxide gas in submarines. Lithium aluminum hydride is a recent reducing agent gaining in application. Air conditioning (with lithium bromide or other lithium salt solutions as refrigerants), lithium soaps in lubricants, glass and ceramics, welding fluxes, storage batteries (electrolyte), detergents (lithium hypochlorite), and organic synthesis are some of the actual or potential outlets for lithium compounds.

SODIUM

Sodium, in the strict sense, does not belong to the less common metals. It is made on a fairly large scale by the electrolysis of molten sodium chloride and is sold in carload lots at about 18 cents per lb in the form of bricks under kerosene or as liquid in heated tank cars. The estimated U. S. production capacity is 140,000,000 lb per year, and planned expansion will soon raise this to 210,000,000 lb per year. The bulk of the production goes into the manufacture of such chemicals as sodium alky sulphate (about 19 per cent), sodium cyanide (about 19 per cent), sodium peroxide (about 4 per cent), and above all, tetraethyl lead (about 53 per cent). Application in the manufacture of synthetic rubber is believed to have been outmoded to a considerable extent by superior methods. Sodium amalgam is used as the intermediate in the production of sodium hydroxide in the electrolytic mercury cell.

The minor metallurgical uses of sodium include application in certain bearing alloys of lead where the addition of sodium has been found to increase the hardness; the removal of arsenic and antimony from lead-tin alloys; hot-dip coatings showing increased wetting power; and the deoxidation of metal baths. In this last use, sodium hydride made from metallic sodium is competing with the metal. The hydride is also used for descaling of steel.

Sodium, a soft, silvery metal, melts at about the boiling temperature of water and has been used as a heat-transfer medium in a temperature range of 400–800 C. At higher temperatures, its vapor pressure becomes appreciable, the boiling point at atmospheric pressure being about 900 C. Of interest are experiments to take advantage of the electrical conductivity of sodium, which on a weight basis is about 3 times that of copper. For this purpose the metal is enclosed in a sheath of iron or steel.

The use of sodium-potassium alloys, which are liquid at room temperature, has been proposed in place of mercury. There is a considerable hazard involved in such potential applications because of the instability of the metal in humid atmospheres and its violent reaction with water. Sodium is an excellent deoxidizer or getter, generally so used in an inert atmosphere. When it is added to molten metal, special precautions are necessary in order to avoid injury by spattering of material of such a low boiling point and high reactivity.

Contributed by the Petroleum Division and presented at the Petroleum Mechanical Engineering Conference, Tulsa, Okla., September 24–26, 1951, of The American Society of Mechanical Engineers.

### CALCIUM

Calcium in its behavior stands between sodium and magnesium and has great similarity to lithium. It is in a much truer sense a "minor metal" than sodium, although during the war, the New England Lime Company in Connecticut produced as much as 5 tons a day by an aluminothermic reduction process in vacuum. Most of the metal went into the manufacture of calcium hydride, a portable source of hydrogen for military purposes and much cheaper than lithium hydride. The electrolytic production of calcium is difficult because the last traces of water are not removed easily from the highly hygroscopic salt without decomposition. Also, a high voltage is required for the electrolysis, resulting in appreciable power cost. Consequently, the cost of a pound of calcium has been about $2, and even a calcium-silicon alloy of about 33 per cent calcium costs about 18 cents per lb.

Like sodium, calcium is a silver-white metal which in air, is rapidly covered with a white layer of oxide. It is much harder than sodium, and less reactive. Owing to the low solubility of calcium hydroxide, even the reaction with water is sluggish. The reaction with hydrogen at higher temperatures is rapid and used technically for the manufacture of calcium hydride.

Calcium is an excellent reducing agent in extractive metallurgy. For instance, it has been used to reduce the oxides or other compounds of chromium, thorium, titanium, uranium, and zirconium. In ferrous metallurgy, calcium-silicon and calcium-manganese-silicon alloys have shown promise as deoxidizers as well as effective decarburizers and desulphurizers. Calcium has been mentioned as an alloying constituent in many nonferrous alloys and is used as a hardener in lead alloys for cable sheathing and in the grids of storage batteries. Also of some importance are certain lead-base bearing alloys containing small amounts of sodium, calcium, and other Group II metals as hardeners. In the manufacture of magnesium, calcium may be added to control the grain size of the ingot, but an excess is detrimental.

### BERYLLIUM

If there were a large and concentrated supply, beryllium would be a metal of major importance. Even under present circumstances, when a pound of beryllium as a 4 per cent beryllium-copper master alloy costs about $30, beryllium is indispensable in certain applications. The only commercial source for the material at the present time is beryl, of which an annual maximum of about 300 tons is produced domestically. While the annual import was several thousand tons during the war years, it was only 1000 tons in 1946, with a metal content of 3 or 4 per cent. The metal is prepared commercially by the electrolysis of its oxyfluoride.

Only part of the ore goes into the metallurgical market. Beryllium oxide is an excellent refractory and, before the war, an estimated 100–200 tons of beryl were used for this purpose. The melting point of beryllium oxide is 2500 C, and addition of even moderate amounts of beryllium oxide to refractories imparts a remarkable resistance to corrosion, cracking, and thermal shock, at the same time improving insulating properties. The presence of beryllium compounds in fluorescent lights has been brought to the foreground recently in connection with their toxicity.

The use of beryllium in alpha-ray emitters and as a potential moderator in the atomic pile (instead of carbon) cannot be discussed in this summary review. Both uses and the tremendous theoretical interest in beryllium are closely connected with its low atomic weight. Small windows of 1 to 2 mils thickness are used in x-ray tubes, beryllium being more easily penetrated by x rays than any other metal.

The technical significance of beryllium is based on its use in precipitation-hardening alloys, particularly in copper alloys. It has outstanding ability to improve the mechanical properties of alloys when added in small percentages. It also seems invariably to transfer at least part of its own corrosion resistance to whatever metal it is added. Important are the beryllium bronzes, which approach quenched steel in hardness and tensile strength and show excellent resistance to shock, wear, and fatigue. They are also nonmagnetic and nonsparking. A typical alloy, which is 6 times as strong as pure copper, contains 2.25 per cent beryllium. Addition of cobalt to copper-beryllium alloy has resulted in very interesting new materials requiring even less beryllium.

Beryllium additions to certain aluminum alloys hold some promise, and beryllium-nickel alloys have shown outstanding characteristics, but are in use only for very specific minor instrument parts. Some of these alloys have been made by powder-metallurgical techniques. The metal possesses the very low density of 1.8 and a high modulus of elasticity (42,000,000 psi). It is worked with difficulty, being rolled, swaged, or extruded under suitable protection at 750 C. Tensile strengths of 40,000–50,000 psi and an elongation of 2 per cent have been reported for extruded beryllium.

Beryllium has been a much glamorized metal, but even after all the exaggerations and publicity claims have been discounted, an extremely useful minor metal remains. It is prevented from becoming a large tonnage product by the fact that nature has given us this metal in very low concentration.

### BORON

Whether or not boron is a metal is a question which may be argued at length, but we shall consider it here, since the element is a constituent of a number of alloys. It is marketed principally as a ferroalloy and the production is only of the order of 10–20 tons per year. This amount is not negligible, because additions of as little as 0.001 to 0.003 per cent to steel appreciably increase the hardenability. Thus boron during the war had become an important substitute for part of the molybdenum in nickel and manganese-molybdenum steel. It is commercially traded as a ferroalloy, and is rather expensive, a 17.5 per cent boron alloy being quoted at $1.20 per lb. Considering the saving of appreciable amounts of other additions by very small percentages of boron, the price is not prohibitive.

The boron alloys available are ferroalloys containing 10–19 per cent boron, manganese-boron containing 15–20 per cent, and nickel alloys of similar content. Because of the ready oxidation of boron, frequently low-boron alloys containing anywhere from a few tenths of one per cent to a few per cent in combination with other desired constituents are added to the steel base. Boron steels are used in the atomic pile as controls, since boron absorbs neutrons very efficiently.

The use of boron as a grain-growth inhibitor in aluminum alloys has been recommended. Boron carbide is a potential replacement for industrial diamonds. Nickel-boron and chromium-boron find use as alloys for hard-surfacing and cutting tools. Apparently the element is of potential interest as a solid high-energy fuel since its chemical equivalent weight is only 3.6.

### GALLIUM

Gallium occurs in extremely low concentrations in some zinc ores and in a few rare minerals, such as germanite, found mainly in Germany and South Africa. Ashes of certain British coals and residues of electrolytic refining processes contain minute amounts of gallium. Either flue dust or the residue of zinc distillation are, besides germanite, the available technical sources. The price is about $3 per gram.

Gallium in its chemical behavior very much resembles aluminum. The only technical uses known are those of the metal itself and some alloys. Gallium has a density of about 6, looks like a low-melting amalgam, and melts in the palm of the hand. Its melting point is only 30 C, whereas its boiling point is 2070 C. Thus the metal has been used in quartz thermometers at temperatures far above those at which mercury could serve. Numerous other uses have been proposed: A liquid aluminum alloy to replace mercury; a number of alloys taking advantage of gallium's low melting point for metal baths, and so forth; dental alloys based on the excellent corrosion resistance of the metal. None of these applications has any substantial volume, however.

### INDIUM

It is an unusual experience to pick up a piece of what appears to be tin or silver and find it soft and flexible like lead. Indium has a density of 7.3, a Brinell hardness number of 1, a melting point of 156 C, and a boiling point of 1350 C. It is a by-product of zinc and lead production and is presently quoted at $2.25 per troy ounce. Its principal use is in bearings where lead or the lead coating on a steel bearing is plated with indium and, subsequently, the plated coat is diffused into the lead at an elevated temperature. A bearing thus treated is less subject to corrosion and wear, and shows better oil retention. The indium alloys technically used and their applications are as follows:

*Gold:* Dentistry and jewelry (indium instead of zinc is used to obtain a low final oxygen content)
*Silver:* In form of silver-indium plate for protecting silverware from tarnishing; jewelry
*Mercury:* Dental amalgam
*Lead-tin:* Solders to resist alkaline corrosion
*Cadmium:* For high-temperature bearings (similar to described application for lead bearings)
*Bismuth:* For low-melting alloys
*Zinc:* A zinc-indium alloy has been used for applying a noncorrosive plating to steel airplane propellers

Recently an indium-containing solder has been marketed which will adhere to both glass and metals. The use of this solder is limited by rather narrow temperature requirements, but it has found some laboratory application.

At the present time, nonmetallic uses of indium are rather unimportant. It is employed to color art glass. Artificial radioactivity is easily introduced in indium by neutrons of low energy, which accounts for its use as an indicator in the atomic pile.

### THALLIUM

All the domestic production of thallium stems from cadmium flue dusts in the operations of the American Smelting and Refining Company at Denver, Colo. Present price is $12.50 per lb.

Contrary to the other members of its family, thallium is not used principally as a metal, but in its compounds as a fungicide, insecticide, and rodenticide (rat poison). However, the demand for thallium is shrinking since it is being replaced by organic compounds less toxic to human beings and more readily soluble.

All other uses of thallium are comparatively small. Certain organic salts (formate, malonate) are used for liquids of high specific gravity (up to 5), and certain other thallium compounds are light-sensitive, especially in the infrared range. The green flame of thallium salts is employed in pyrotechnics; thallium glasses are used because of their high refractive index, and thallium compounds are said to be superior "antiknock" agents to those used. The metal itself is added to increase the sensitivity of selenium cells and permits the safe operation of mercury-vapor rectifiers and of electric vapor lamps.

### GERMANIUM

Germanium is obtained as a by-product of cadmium-zinc recovery. The metal is made by hydrogen reduction of high-purity oxide prepared by several chemical-purification treatments. The price varies between $100 and $200 per lb for the element.

Germanium has a nonmetallic crystal structure similar to the diamond, although superficially it resembles a metal. It is a semiconductor, and its outstanding use lies in the electronic field (crystal detectors and rectifiers).

A great number of alloys have been prepared and technical benefits have been claimed for their use. Of some interest perhaps is the addition of germanium to gold, because the eutectic alloy expands upon solidification, and many of the alloys are extremely fine-grained. This suggests use in jewelry and dentistry. The alloys with silver behave similarly. Platinum alloys also have been made, and many light metal alloys have been reported. The systems germanium-copper (where germanium, like silicon, increases hardness) and germanium-iron have been studied. A new glass showing an exceptionally high index of refraction has been developed in which germanium dioxide replaces silica.

### TITANIUM

Titanium appears to be potentially the most important of all the metals discussed in this paper. Titanium alloys now under development should find widespread use in applications requiring a combination of high strength and light weight such as aircraft and air-borne equipment, and applications involving service up to about 1000 F such as engine parts. The metal will wet glass and some ceramics, thereby offering possibilities as a solder for joining these materials to metals. Although it is an extremely reactive metal, it protects itself with an adherent oxide giving excellent corrosion resistance in atmospheric and salt-water service.

Plentiful titanium deposits (Ilmenite) are on the North American continent which should eliminate strategic shortages once production is under way. Principal deposits are in New York, Quebec, Florida, and Virginia. At present the metal is produced by magnesium reduction of titanium tetrachloride but extensive and promising research is under way on less expensive methods. At the current price of $5 per lb for sponge and $6 to $15 per lb for fabricated forms, the demand far exceeds the supply (estimated at 200 tons per year). However, the government is pushing development of titanium supplies because of its great interest to the military and apparently will offer some financial inducement for greater production in the immediate future.

Industry also sees in this metal a tremendous potential, as evidenced by the amount of research currently being done on production of the sponge, and melting, alloying, and fabrication of the metal; and also by the number of companies being formed to produce and market it. If and when a continuous process is developed for production of the sponge, industry immediately will invest upward of $200,000,000 in plant and equipment.

The composition and properties of some of the more promising alloys are given in Table 2.

The metals department of Armour Research Foundation has carried out extensive work on titanium, including such specific problems as development of a less expensive extractive process, melting and fabrication techniques, phase-diagram studies, heat-treating research, and alloy development. Because of its highly reactive nature with refractories and the atmosphere at elevated temperatures, titanium and its alloys are melted in an inert-atmosphere tungsten-electrode arc furnace utilizing a water-cooled copper mold.

TABLE 2 COMPOSITION AND PROPERTIES OF TITANIUM-BASE ALLOYS

| | | Percentage composition (balance Ti) | | | | | | | Mechanical properties | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alloy | Supplier | Cr | Fe | O | N | C | Mn | Al | Ultimate strength, $10^3$ psi | Yield strength, $10^3$ psi | Elongation, per cent | Hardness VHN | Impact Charpy V-notch | Fatigue at $10^8$ cycles, $10^3$ psi |
| Ti-75A | Titanium metals | .. | 0.10 | ? | 0.02 | .. | .. | .. | 70–80 | 45–55 | 20–30 | 175 | 15–25 | 45 |
| Ti-100A | Titanium metals | .. | 0.1 | ? | ? | 0.02 max | .. | .. | 100 | 75 | 20–25 | ...... | .... | ...... |
| Ti-125A | Titanium metals | 1.8 | 0.9 | 0.15 | 0.02 | 0.02 | .. | .. | 125 | 80 | 18–20 | ...... | .... | ...... |
| Ti-150A | Titanium metals | 2.7 | 1.3 | 0.25 | 0.02 | 0.02 | .. | .. | 150 | 130 | 12–20 | 334–500 | .... | 70 |
| Ti-175A | Titanium metals | 3.0 | 1.5 | 0.5 | 0.04 | 0.02 | .. | .. | 175 | 160 | 10 | ...... | .... | ...... |
| Ti-Mn | Rem-Cru | .. | .. | ? | ? | ? | 7 | .. | 150 | 140 | 12–15 | 330–350 | .... | 75 |
| Ti-Mn-Al | Rem-Cru | .. | .. | ? | ? | ? | 4 | 4 | 145 | 135 | 15–20 | 330–350 | 13 | 80 (approx) |
| Ti-Cr-Al | P. R. Mallory | 5 | .. | ? | ? | 0.4 | .. | 3 | 165 | 135 | 10 | ...... | .... | ...... |

High-carbon ferrotitanium is employed as a deoxidizer and scavenger in steel; and in medium and high-carbon-killed steel, it is used as a final deoxidizer to prevent segregation and the occurrence of objectionable inclusions, and occasionally to control grain size. This grade (15–19 per cent) sells for about 50 cents per lb of alloy.

Low-carbon ferrotitanium (0.10 per cent C maximum) selling for about $1.35 per lb of alloy is used largely for the production of "stabilized" austenitic chromium-nickel steels where it prevents intergranular corrosion and embrittlement by stabilizing the carbon as titanium carbide. It also has been used for stabilizing the carbon in plain chromium steels to prevent hardening during rapid cooling in air. Titanium is added to enameling iron to stabilize the carbon again, preventing reaction with water vapor which gives hydrogen "reboiling."

### ZIRCONIUM AND HAFNIUM

Zirconium and hafnium are so closely related that a joint treatment appears justified, the more so since the technical importance of hafnium is nil. Zirconium, on the other hand, has been gaining continuously in the number and extent of its industrial applications, and it is perhaps significant that the total ore shipments to the United States of over 20,000 short tons in 1946, exceeded those of the preceding year by more than 25 per cent, and that the 1947 production again showed an increase of 50 per cent.

Zircon, $ZrSiO_4$, is the main source of zirconium and its compounds. It is mined in Australia, Brazil, and India, and in a number of smaller deposits on all continents. A substantial domestic production has been established in Florida from the black sands of Vero Beach and from dune sands near South Jacksonville. Twelve to fifteen per cent zirconium-ferrosilicon is quoted at 7 cents per lb of alloy and 35 to 40 per cent material at 21 cents per lb of alloy; pure metal powder is listed at $7 to $8 per lb. One gram of hafnium costs about $75.

Only about $^1/_4$ of the zirconium is used in the form of metals and alloys; $^1/_4$ to $^1/_2$ goes into refractories, and roughly, 50 per cent into enamels, porcelain, and glasses. Recently it has been reported that zirconium prevents plutonium from being deposited in living bone marrow of animals—an interesting sidelight upon the extent to which atomic-energy work reaches in all phases of chemistry.

The use of $ZrO_2$ in refractories and porcelains is based on its extremely high melting point—about 450 C higher than that of quartz—and on its excellent chemical resistance, and electrical and mechanical qualities. A zirconia-point cathode for a high-intensity white light (Nernst lamps) is also based upon the high melting and boiling points of the oxide. It appears noteworthy that a greatly increased application of zirconium oxide in the refractories of blast furnaces in Russia has been reported in connection with the conversion of Russian blast furnaces to the use of oxygen and the resulting higher temperatures of operation. Since the end of the war it has been one of the principal aims of metallurgical and ceramic research to find materials which will retain useful qualities at higher and higher temperatures. The availability of such materials is a necessity for the future development of gas turbines, jet propulsion, and rockets. Zirconium and titanium as metals, alloys, and oxides are among the substances that hold most promise in this respect.

Zirconium metal, because of its high boiling point and its affinity for oxygen and nitrogen, has been used as a getter in vacuum tubes. It is pyrophoric at higher temperatures and has been used in flash bulbs and pyrotechnics. Zirconium dust can be ignited with a weaker electric spark than any other material. The metal has superior corrosion resistance to acids as well as caustic solutions. Fully annealed, it is ductile and easily shaped or drawn into wire. It has a high capacity for work-hardening. Many zirconium alloys have been studied to an appreciable extent, and some of these have achieved industrial significance. Considerable research is under way on zirconium alloys at the Armour Research Foundation.

Two grades of zirconium ferroalloys are used in steelmaking; one containing 35–40 per cent zirconium and over 50 per cent silicon, and one containing 12–15 per cent zirconium and roughly, 40 per cent silicon. Zirconium is added to steel in amounts between 0.05 and 0.20 per cent, as a deoxidizer and grain-refining agent. Zirconium is an excellent scavenger for oxygen, nitrogen, and sulphur. The addition of zirconium to a number of high-quality steels such as nickel, chrome, vanadium, and particularly manganese steel, has been found advantageous and is practiced commercially especially where highest ductility for wrought products is desired.

The solubility of zirconium in aluminum has been studied. Several publications deal with small zirconium additions to magnesium-base alloys which are said to result in grain refinement. The decreasing solubility of zirconium in copper with lower temperature gives an age-hardening alloy. Zirconium-containing bronzes also have been made. A number of high-melting-point alloys with tungsten, molybdenum, vanadium, and tantalum have been reported, and zirconium-tungsten alloys have been used in vacuum tubes.

### VANADIUM

Colorado, Utah, and Arizona sandstones are at present the main source of vanadium. The phosphate rocks of Idaho, extensive vanadium-bearing shales of Idaho and Wyoming, and New York's titaniferous magnotite ores, are other actual or potential domestic sources. Roscoclite, a vanadium-bearing mica, is the other important mineral. World production (excluding Morocco, Spain, and Russia) of the ore in 1947, approximated 1750 tons of contained vanadium. The price of this metal as ferrovanadium is about $3 per lb.

A detailed description of the metallurgical application of

vanadium would require much more space than is available here. More than 90 per cent of the total production is used in steel manufacture, and more than 50 per cent of that amount in high-speed steel. The formation of vanadium carbide, its solubility, and the resulting influence on the steel structure are important factors in these alloy steels. Of special technical importance is the retention of hardness by vanadium steels at elevated temperatures. Increase in oxidation and corrosion resistance, higher endurance limits, and prevention of age-hardening are some of the advantages gained with vanadium in steel.

Addition of 0.1–0.5 per cent vanadium to gray cast iron increases tensile strength, transverse strength, and hardness. In highly alloyed irons, 0.12 per cent vanadium gives improved machinability. The manganese-vanadium or chrome-vanadium alloy steels are used where particularly high strength is required at slightly elevated temperatures (400/500 F). For instance, a steel with 0.50 per cent carbon, 0.79 per cent manganese, 0.31 per cent silicon, 0.90 per cent chromium, 0.20 per cent vanadium oil-quenched from 1545 F and tempered at 800 F has a Vickers hardness of 481 and a tensile strength of 233,000 psi.

Vanadium is not used in the United States to a great extent in stainless steels or in high-temperature alloys. Germany, however, poorer in many of the other metals, has substituted vanadium for such purposes with good success. Some special alloys like the highly magnetic Vicalloys (iron, cobalt, and vanadium), some bronzes, and a Hastelloy (Ni, Mo, [Cr, Fe]) with some vanadium should be mentioned.

The use of vanadium (replacing platinum) and vanadium oxide as catalysts in chemical process industries consumes more than 3 per cent of the vanadium production.

A ductile vanadium metal has been developed just recently with properties varying from 81,000 psi tensile strength and 7 per cent elongation for annealed metal to 155,000 psi tensile strength and 1 to 2.5 per cent elongation for 80 per cent cold-rolled metal. With an elastic modulus of 22,000,000 psi, a density of 6.1, and a melting point of 3150 F, vanadium alloys may find use for applications requiring light weight and high strength at elevated temperatures. One big problem to be overcome is its tendency to oxidize above about 600 F. Considerable improvement on these properties is anticipated with suitable alloying which is now being investigated in a research project at the Foundation.

### COLUMBIUM[1]

Columbium is found together with tantalum in the ore columbite, a columbate, and tantalate of iron and manganese, crystallizing in the orthorhombic system and occurring in granitoid rocks. If the tantalum content exceeds that of columbium, the mineral is called tantalite. The domestic production of the ore is very small, the bulk of columbite being imported from Nigeria where it is a by-product of the mining of tin-bearing sands.

The metal is made by aluminothermic reduction, by reduction with coal, or by electrolysis of fluorides. The ferroalloy is obtained in electric furnaces by silicon reduction. About 4,000,000 lb of columbium was mined during the years 1944–1946. The price as 50–60 per cent ferrocolumbium is about $4.90 per lb of alloy. The metal has been quoted at $62 per lb.

Columbium in additions of 0.5–0.8 per cent is used in stabilizing stainless steels (chrome-nickel steels). By combining with the carbon, columbium prevents carbide segregation in the grain boundaries which is responsible for intergranular corrosion. This is particularly important in welding grades of stainless where the heat-affected metal is subject to carbide precipitation. Columbium further serves to reduce air-hardening in noncorrosive chromium steels. An important outlet for columbium (and tantalum) is use in nitrided alloy steels. Nitriding in cracked ammonia results in an extremely hard surface layer containing nitrides, e.g., of chromium and aluminum. Columbium addition increases the rate of growth and depth of the nitride layer and allows higher nitriding temperatures without embrittlement. Finally, it is an important constituent in new, high-strength, high-temperature alloys used for rotors in gas turbines and in exhaust systems.

[1] The International Union of Chemistry has agreed to standardize on the name "niobium" for this element. It is expected that 'niobium' gradually will be adopted in this country instead of the older term "columbium."

### TANTALUM

Tantalite, the most important tantalum ore, as already mentioned, is identical with columbite, only richer in tantalum. The Belgian Congo and to a lesser extent Brazil are the main exporters of the ore to the United States. About 1,000,000 lb of tantalum was mined for the years 1944–1946.

The metal itself is prepared by fused-salt electrolysis or by reduction of its halides with metals of the first or second group of the periodic system. Powder-metallurgical methods are used for fabricating the metal. Tantalum sheet costs about $70 per lb.

Tantalum metal possesses exceptional corrosion resistance. It is used for surgical purposes such as sutures and cranioplastic (skull plates) because of its compatibility with body tissue. Its corrosion resistance has made tantalum an indispensable material of construction for chemical apparatus such as tantalum heat exchangers and tantalum-clad acid-proof equipment. It is also used in electronic and radar equipment as anode and grid elements. The ease with which tantalum is covered electrolytically with a self-healing layer of oxide has promoted its use in rectifiers, condensers, and lightning arresters. Tantalum carbide is one of four commercial carbides (Ti, W, Mo, Ta) which are formed into dies (for wire drawing), cutting tools, or machine parts of extraordinary hardness and wear resistance.

Because of its tendency to form nitrides and carbides and high melting point, tantalum must be worked by powder-metallurgy methods and sintered in vacuum. It is worked cold and suited to forming by all conventional methods such as rolling, drawing, pressing, and so forth. For higher mechanical strength and higher annealing temperatures it may be alloyed with tungsten by powder methods.

Tantalum cannot be electroplated, but through hydrogen reduction of the pentachloride it has been possible to cover metals and various other materials such as ceramics with a dense and nonporous continuous coating of tantalum which adheres well and provides good corrosion resistance.

### MOLYBDENUM

The United States is the main producer and consumer of molybdenum, Utah and Colorado being the principal sources of supply. The annual consumption of molybdenum is about 11,000 short tons. It is also produced as a by-product of copper-ore concentration. It is traded in the form of 90 per cent ore concentrates, ferromolybdenum, calcium molybdate, trioxide, molybdic acid, ammonium and sodium molybdate, metal, alloy and silicide. The price is $1.32 per lb of contained molybdenum in the form of ferromolybdenum, and is slightly lower for oxide (powder or briquettes) and calcium molybdate.

It is much beyond the scope of this review to discuss the metallurgy of molybdenum in detail. Summarizing, it can be said that moly is one of the most important hardening elements for steel. It raises the grain-coarsening temperature of austenite, increases hardenability, minimizes temper brittle-

ness, and is one of the most effective elements that can be added to steel to increase its mechanical and creep strength at higher temperatures. Molybdenum may replace part or all of the tungsten as the principal alloying element in high-speed steels. In many cases it definitely increases corrosion resistance, for instance, in acidproof chromium steels.

Molybdenum is equally effective in cast iron and is commonly used for high-strength and corrosion-resistant castings. The Hastelloys, nickel-molybdenum-base alloys of excellent heat and corrosion resistance, are used extensively in heavy-duty chemical equipment. Some typical uses of molybdenum alloys are in jet-propulsion engines, gas turbines and turbosuperchargers, as supports in incandescent lamps, in electrical contacts, heating elements, resistance-welding electrodes, and x-ray targets. A molybdenum-tungsten thermocouple has been used experimentally. Glass-metal seals in the electronic industry is another application for molybdenum alloys.

The pure metal is of less technical significance. Generally, powder-metallurgy methods are used for its preparation, but it is now available in the form of sheets, rods, tubes, and wire. High modulus of elasticity and high tensile strength, especially after cold-working, are remarkable characteristics of molybdenum. However, the advantage is minimized greatly by its rapid oxidation at fairly low temperatures. Methods for coating the metal with ceramic materials and with titanium have been proposed. Molybdenum itself is not readily electroplated but some alloys have been electrodeposited successfully from molten baths. Molybdenum coating by thermal decomposition of its volatile hexacarbonyl compound is also possible.

A moderate amount of various molybdenum compounds, perhaps 10 per cent of the total, is used in the glass, ceramic, enamel, electric, dye, leather, and ink industries. Its use as a fertilizer in deficient soils has been described.

### TUNGSTEN[2]

Scheelite, a calcium tungstate; ferberite, an iron tungstate; and wolframite, a manganese tungstate, are the principal commercial sources for tungsten. The annual U. S. production of ore concentrates in 1945 and 1946 was somewhat over 5000 tons, containing roughly 5,000,000 lb of tungsten. During the war years this production doubled. The domestic-ore production represents roughly 40 per cent of the total consumption. The principal domestic producers are California, Nevada, and Idaho, but a number of other states and Alaska produce smaller amounts. Import sources are spread all over the world, the most important ones being China, Bolivia, and Brazil. The richest ore deposits are probably those in China. The average value of ore concentrate varies greatly; ferrotungsten costs \$3.25 per lb of contained tungsten.

Tungsten is a very unusual metal. Steel gray with a bright metallic luster, it has a density of 19.3, about the same as gold, and exceeded only by rhenium and some of the platinum metals. It has the highest melting point of all metals, about 3400 C, and the highest boiling point (6170 C). At 4000 C its vapor pressure is only $^1/_{1000}$ atm. The modulus of elasticity is the highest for any metal, 53,000,000 psi.

Of the primary tungsten production, ferrotungsten represents almost 50 per cent, tungsten metal powder 30–40 per cent, special alloys 3–4 per cent, and such products as sodium tungstate, tungstic oxide and acid, and ammonium paratungstate the remaining 10–17 per cent.

The massive metal itself is not easily made, and powder methods must be applied. The powder obtained by reduction of the oxide with hydrogen is compacted, sintered in a hydrogen atmosphere, and worked at successively lower temperatures until it becomes ductile and can be drawn through dies into fine wires. The unique combination of high mechanical properties, high melting point, low vapor pressure, and good conductivity has given the metal its unique position for electric filaments. It has practically the same expansion coefficient as Pyrex glass. Inert-arc and atomic-hydrogen welding processes use tungsten electrodes. A plating procedure by thermal decomposition analogous to that reported for tantalum has been worked out.

Most of the tungsten, however, is consumed in alloy steels, particularly in high-speed tool steels, and in shock-resisting and hot-work tool steels. The tungsten content varies between 2 and 24 per cent, introduced in the form of ferrotungsten. This is usually made by reduction of mixtures of the ore (wolframite) and iron oxide or scrap with carbon in an electric furnace. The alloys also are made in an electric furnace, whereby tungsten powder or calcium tungstate replaces ferrotungsten for the production of nonferrous alloys.

As an alloying element in steel, tungsten imparts great strength at elevated temperatures and greater toughness for the same hardness. 18-4-1 steel (18 per cent W, 4 per cent Cr, 1 per cent V) and 6-6 steel (6 per cent W and 6 per cent Mo) are typical examples of tungsten tool steels, perhaps the most important of all high-speed tool steels. Tungsten-chromium steels are used in permanent magnets. High-carbon-tungsten steels find considerable use for abrasion resistance.

In nonferrous alloys, tungsten is equally useful. Cobalt-chromium-tungsten-molybdenum (Stellite family) alloy tools show excellent red hardness and are superior to high-speed steels in some metal-cutting operations, dies, gages, and earth-working equipment. The softer and tougher compositions are used in heat-resistant castings, such as gas-turbine buckets. These alloys are usually cast and finished by grinding. Some of them are applied as welding rods for the purpose of hard-surfacing.

Some minor uses include a silver-tungsten alloy for electrical contacts, platinum-tungsten alloys for spark plugs and radar-tube grids, and copper-tungsten for high-pressure resistance-welding electrodes and high-density counterweights.

Of extreme technical importance is the use of tungsten carbide having a hardness of more than 9 on Moh's scale. It finds wide use as a cutting-tool material and wherever very high-abrasion and heat-resistant qualities are required. For cutting steel, titanium, tantalum, and/or molybdenum-carbides are added, since they resist cratering better than straight tungsten carbide. Mainly the monocarbide is used. The powder is made from tungsten, and/or tungsten oxide with carbon, and shaped either by cold-pressing and subsequent sintering or by hot-compacting in one operation. Shaping by extrusion with a following sintering operation is used for special applications.

In comparison to the use of tungsten in alloy steels, other alloys, and in carbide, the nonmetallic uses of the compounds as fire-retarding agents, as bronze-colored pigments, in fluorescent screens, and as phosphors in luminescent materials are of minor technical importance.

### SELENIUM AND TELLURIUM

All selenium and most of the tellurium production results as a by-product of tank slimes of electrolytic copper refining. Some of the tellurium is obtained from lead operations. The annual production of selenium in 1946 dropped to less than one half of its wartime peak of 600,000 lb. Tellurium production in 1942 exceeded 200,000 lb, but was only 55,000 to 80,000 lb in the following years, and negligible in 1946. In 1947 it again

(*Continued on page 18*)

[2] The International Union of Chemistry has agreed to standardize on the name "wolfram" for this element. It is expected that wolfram will be adopted gradually in this country instead of the older term "tungsten."

# *Recent* DEVELOPMENT *of the* REHEAT STEAM TURBINE

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PRESENT conditions, such as high fuel costs, larger unit capacities, and high operating load factors, have made the use of the reheat cycle increasingly attractive. As evidence of this increased interest, several papers have been presented in the last three years covering various aspects of reheating, such as improvement in thermal efficiency, operating experiences, and the effect of this cycle on the design of power-plant equipment.

In this paper we will review briefly the advantages and disadvantages of the reheat cycle, point out the degree of acceptability of this type of turbine, describe typical turbine designs, and discuss operating experiences and problems.

### ADVANTAGES OF REHEAT CYCLE

Advantages derived from the reheat cycle, as have been discussed in several papers, are as follows:

1 Increase in thermal efficiency of the turbine of from 4 to 5 per cent when reheating to the initial steam temperature (Fig. 1).

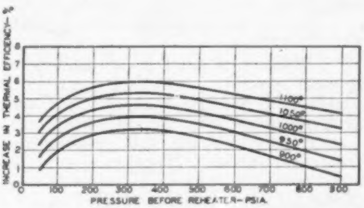


FIG. 1 INCREASE IN THERMAL EFFICIENCY
(Steam conditions, 1450 psig, 1000 F total temperature, 1.5 in. Hg abs; 10 per cent pressure drop through reheater.)

2 Reduction in boiler-feed-pump power of from 15 to 18 per cent, which further improves the station heat rate.

3 Reduction in condenser size of from 7 to 8 per cent.

4 Reduction in main steam-generator size because of a reduction of about 15 to 18 per cent in steam flow.

5 Reduction in fuel-burning equipment of about 5 per cent.

6 Reduction of about 50 per cent in percentage of turbine-exhaust moisture.

7 Reduction in size of feedwater heating equipment.

8 Reduction in size of low-pressure blading because of 7 to 8 per cent reduction in volumetric steam flow or, if the same-size blading is used, reduction in the leaving losses from the turbine.

### DISADVANTAGES OF REHEAT CYCLE

1 Additional cost of the reheat section of the boiler, together with the reheat-steam piping from and to the turbine.

2 Increased cost of the steam turbine.

3 Slight increase in complexity of operation and control. These difficulties are, however, less than anticipated and will be discussed further in this paper.

4 Additional turbine floor-space requirements. This additional space is required because of a slightly longer turbine and also because of the space occupied by interceptor valves, dump valve, and reheater piping.

5 Added complication in piping and valve arrangements and in provision for flexibility in the piping system.

### ACCEPTANCE OF REHEAT CYCLE

With present high load factors and fuel costs the use of the reheat cycle becomes quite attractive, particularly in the larger unit sizes (80 mw and above). This is indicated by the curve in Fig. 2 which shows the percentage of reheat turbines now under construction by the author's company.

It will be noted that no reheat turbines are now being built for capabilities of 50 mw or below. However, if the trend toward higher load factors and higher fuel costs continues, the reheat cycle in some cases can be justified for these smaller ratings.

At 75 mw capability the percentage of reheat turbines is rather small, about 12 per cent. Part of the reason for this small percentage at this rating is the demand for units of the ASME/AIEE Preferred Standards, which do not now include reheat turbines in this size range. Consideration is now being given to the addition of a standardized reheat turbine of about this capability, and when and if this standardized reheat turbine is adopted, there is no question but that the percentage of reheat turbines of this size will be increased materially.

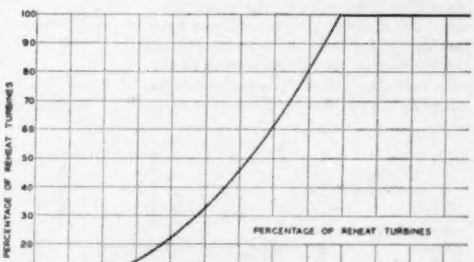


FIG. 2 PERCENTAGE OF REHEAT TURBINES

For larger ratings the reheat unit is becoming more and more popular, with the result that for capabilities of 140 mw and greater, all units now under construction are of the reheat design.

Contributed by the Power Division and presented at the Annual Meeting, Atlantic City, N. J., November 25–30, 1951, of The American Society of Mechanical Engineers.

On the standardized unit of 100 mw capability, both reheat and nonreheat turbines are covered. At the present time all but one of the standardized units under construction, having a capability of 100 mw, are of the reheat design.

Thus there appears to be no question but that the advantages of the reheat cycle have outweighed the disadvantages on the larger units with the trend being toward even greater use of this cycle during this period of high load factors and expensive fuel.

#### STEAM CONDITIONS

The most common set of steam conditions for reheat turbines has been 1450 psig initial pressure, 1000 F initial temperature, and 1000 F reheat temperature. More than one half of our reheat steam turbines have been purchased for these steam conditions.

A continually increasing number of reheat turbines is being purchased for steam conditions of 1800 psig initial pressure, 1000 F initial temperature, and 1000 F reheat temperature. More than 25 per cent of the reheat turbines now being designed and constructed will operate under these steam conditions, with the expectation that this percentage gradually will increase.

In a few cases the quality of fuel available for the boilers has necessitated a reduction in pressure and temperature, to 1250 psig initial pressure, 950 F initial temperature, and 950 F reheat temperature. About 10 per cent of the reheat turbines now being built will operate under these steam conditions. Incidentally, the station heat rate obtainable under these steam conditions is about the same as can be realized with a nonreheat turbine operating under steam conditions of 1450 psig initial pressure and 1100 F initial temperature.

There has been considerable development toward the extension of pressures and temperatures to higher levels. As a result, one turbine is now being designed for steam conditions of 2350 psig initial pressure, 1100 F initial temperature, and 1050 F reheat temperature. These conditions involve the use of austenitic steels in the parts exposed to 1100 F, and these parts accordingly have been designed to be relatively small simple structures with freedom for expansion. In this way, stresses, particularly those due to transient conditions such as occur during starting cycles and load changes, are kept sufficiently low so that reliable operation can be expected for a long period of useful life.

#### ECONOMIC JUSTIFICATION OF REHEAT CYCLE

Factors involved on different installations vary so widely that it becomes difficult to make other than general statements as to when the reheat cycle can be justified economically.

However, it appears logical to conclude that for sizes of 60 mw and larger, load factors above 50 per cent, and fuel costs of 20 cents or more per million Btu, the application of the reheat cycle should receive careful consideration.

#### ARRANGEMENT OF REHEAT STEAM TURBINES

The arrangements of the steam path of reheat turbines now under construction by the author's company are shown diagrammatically in Figs. 3 and 4. Fig. 3 shows tandem-compound turbines driving single 3600-rpm generators, whereas Fig. 4 shows cross-compound types of turbines with the high-

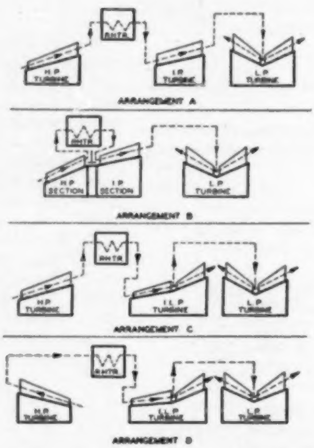


FIG. 3 ARRANGEMENT OF TANDEM-COMPOUND REHEAT TURBINES

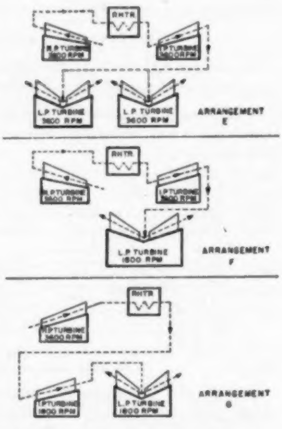


FIG. 4 ARRANGEMENT OF CROSS-COMPOUND REHEAT TURBINES

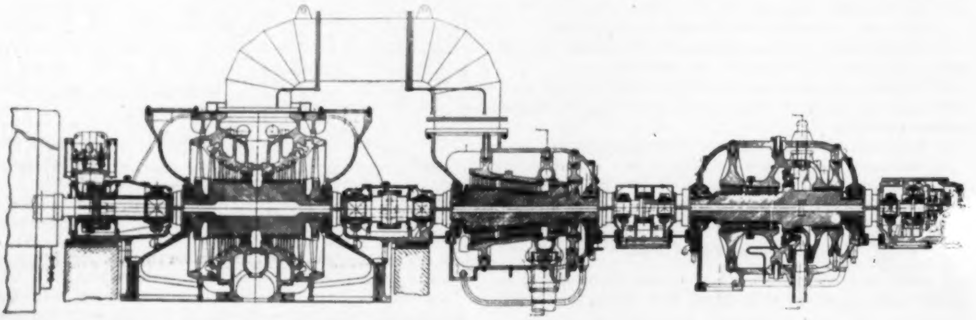

FIG. 5 ASSEMBLY OF 65-MW 3600-RPM TANDEM REHEAT TURBINE, THREE-CYLINDER, DOUBLE-FLOW TYPE

(Steam conditions, 1450 psig, 1000 F total temperature, 1 in. Hg abs; reheat to 1000 F; maximum capability 81,250 kw.)

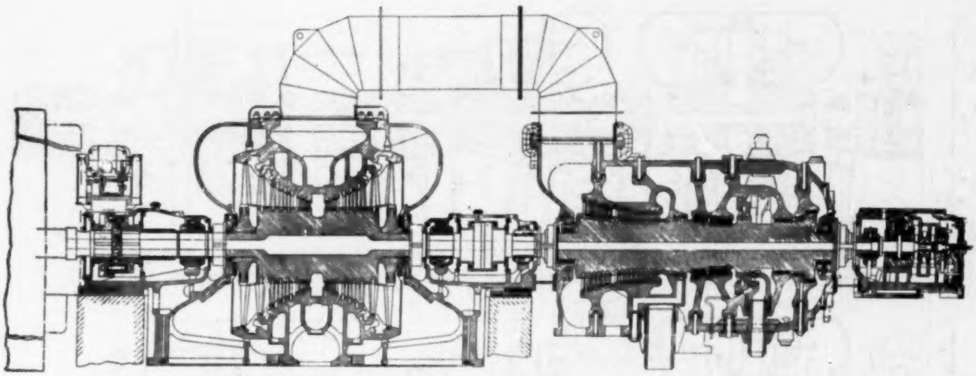

FIG. 6 ASSEMBLY OF 60-MW 3600-RPM TANDEM REHEAT TURBINE, TWO-CYLINDER, DOUBLE-FLOW TYPE

(Steam conditions, 1450 psig, 1000 F total temperature, 1.5 in. Hg abs; reheat to 1000 F; maximum capability 75,000 kw.)

pressure turbine driving a 3600-rpm generator, and the intermediate and low-pressure turbines driving either a 3600 or an 1800-rpm generator.

Arrangement A shows a three-cylinder turbine with steam first passing through a separate high-pressure element, then being reheated before passing through the separate intermediate-pressure element. The steam then divides into two parts through the separate, double-flow, low-pressure element. This forms a three-cylinder turbine with steam being reheated between the high and intermediate-pressure elements. A longitudinal section through a turbine of this type is shown in Fig. 5.

In arrangement B the high and intermediate elements are combined into a single cylinder. As shown, steam flows in the same direction through the high and intermediate-pressure sections, which means that near the center we have a separating seal across which the pressure differential is quite small, being the same as the pressure drop through the reheater and its piping. This construction results in a difference in temperature on the two sides of the separating partition, this differential being of about the same magnitude as that across a conventional reaction-blade ring.

Arrangement C is used on larger 3600-rpm units, where a third low-pressure blade section is required. In this arrangement the intermediate section is combined with one of the low-pressure sections. Therefore we have a three-cylinder turbine consisting of a high-pressure element, a combined intermediate low pressure element, and a low-pressure element, with steam being reheated between the high and intermediate-pressure elements.

Arrangement D is the same as arrangement C except that the high-pressure element is turned in the opposite direction, thus opposing the blade thrust loads in the high and intermediate-pressure elements. This construction reduces the size of the balancing pistons, which simplifies the casing construction and results in a slight improvement in turbine efficiency.

In arrangement E, both generators run at 3600 rpm. Because of its size, four low-pressure blade sections are required, these being provided by two double-flow low-pressure elements.

In arrangements F and G the low-pressure element consists of a double-flow turbine operating at 1800 rpm. In one case, the intermediate-pressure element is coupled to the low-pressure shaft and runs at 1800 rpm, and in the other, the intermediate pressure is located on the high-pressure shaft and runs at 3600 rpm.

The most common arrangements are B and D, the former being used when a double-flow low-pressure end provides sufficient exhaust area, and the latter when a triple-flow exhaust is required.

### TURBINE-DESIGN FEATURES

The two-cylinder, double-exhaust, construction (type B) is illustrated by the longitudinal section in Fig. 6. Steam is admitted to the turbine through two throttle valves and two governor-controlled steam chests, one set of each being mounted separately on each side of the turbine. The high-pressure casing consists of an inner and outer cylinder. The inner cylinder

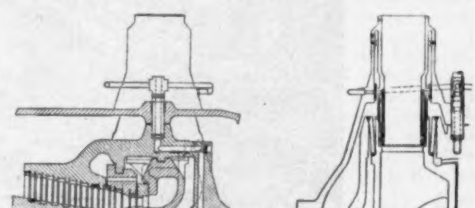

FIG. 7 SECTION THROUGH HIGH-PRESSURE END OF INTERMEDIATE-PRESSURE ELEMENT

(Higher temperature reheat inlet features.)

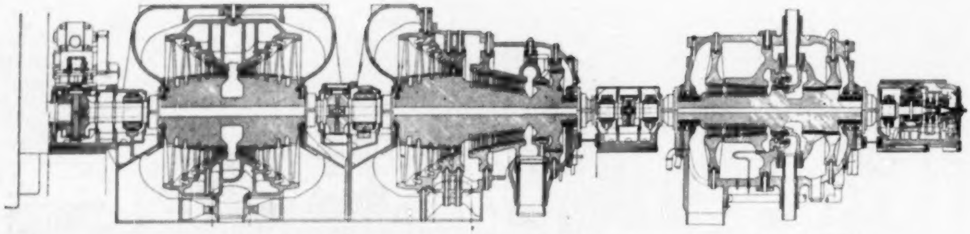

FIG. 8 ASSEMBLY OF 125-MW 3600-RPM TANDEM REHEAT TURBINE, THREE-CYLINDER, TRIPLE-FLOW TYPE
(Steam conditions, 1500 psig, 1050 F total temperature, 1.5 in. Hg abs, reheat to 1000 F; maximum capability 125,000 kw.)

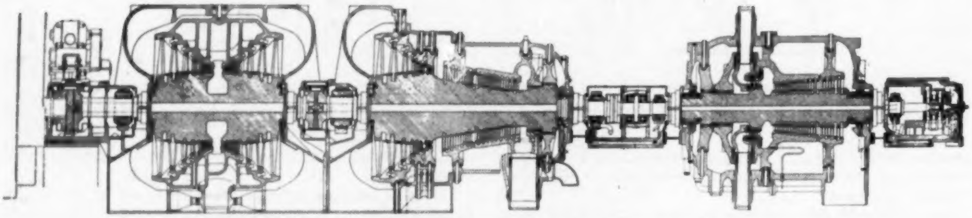

FIG. 10 ASSEMBLY OF 135-MW 3600-RPM TANDEM REHEAT TURBINE, THREE-CYLINDER, TRIPLE-FLOW TYPE
(Steam conditions, 1800 psig, 1000 F total temperature, 1.5 in. Hg abs, reheat to 1000 F; maximum capability 150,000 kw.)

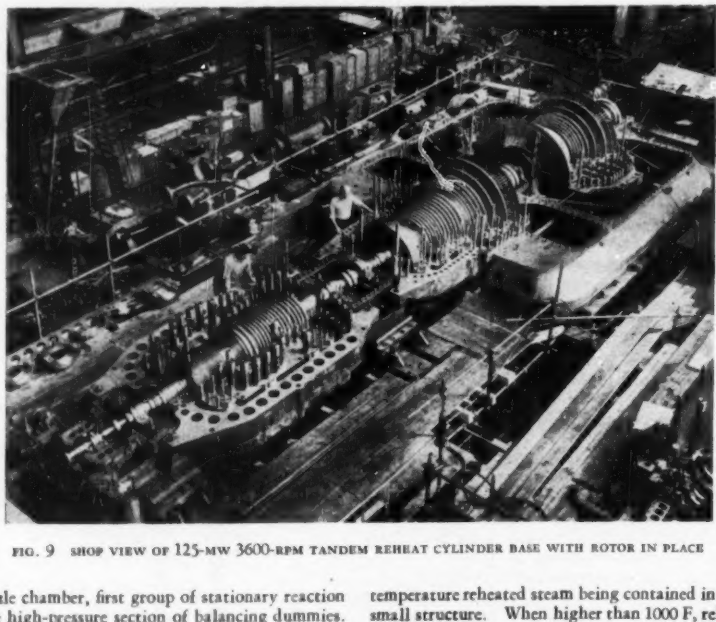

FIG. 9 SHOP VIEW OF 125-MW 3600-RPM TANDEM REHEAT CYLINDER BASE WITH ROTOR IN PLACE

contains the nozzle chamber, first group of stationary reaction blading, and the high-pressure section of balancing dummies. In this way the parts exposed to high-temperature steam are made comparatively small and have freedom of differential movement with the large, relatively cool outer cylinder.

In like manner, the intermediate-pressure section of the cylinder is made with an inner and outer casing with the high-temperature reheated steam being contained in a comparatively small structure. When higher than 1000 F, reheat temperature is used, this intermediate inner cylinder also contains nozzle chambers and impulse blading, which means that the expansion through this impulse element further reduces the size of the parts exposed to the high-temperature steam. A section illustrating this type of construction is shown in Fig. 7.

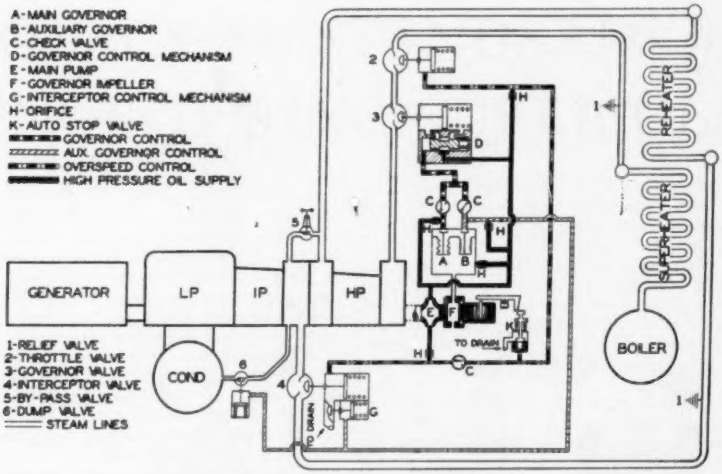


FIG. 11 REHEAT TURBINE CONTROL DIAGRAM

The triple-exhaust construction (type C) is illustrated by the longitudinal section in Fig. 8 and by the shop view in Fig. 9. High-temperature construction is similar to the two-cylinder design. In addition, the intermediate cylinder contains one set of low-pressure blades. Low-pressure double-flow features are similar in the two designs. A section through a turbine having the reversed arrangement of high and intermediate-pressure elements (type D) is shown in Fig. 10.

Of particular interest is the 185,000-kw reheat turbine for Burlington Generating Station of the Public Service Electric and Gas Company, which contains several novel features. In the first place, steam conditions are higher than formerly used, 2350 psig inlet pressure, 1100 F initial temperature, and 1050 F reheat temperature. Then too, the substantial increase in rating over previous 3600-rpm units dictates the use of a triple-exhaust 25-in-long low-pressure blade, making this the first application for a blade of this length at this speed.

Also, the 1050 F reheat temperature exceeds by 50 F the highest now in service. The single-wheel impulse element, used in the reheat section, reduces the steam temperature in the inner cylinder to about the same value as in the 1000 F reheat design.

## REHEAT CONTROL

Fig. 11 is a diagrammatic arrangement of the control of a reheat turbine. For simplification, the superheater is shown as a single element. Actually, in most cases, the superheater is divided into two sections with the reheater being interposed between the primary and secondary superheater elements.

Steam passes from the main steam generator through the throttle valves and governor valves. After expanding through the high-pressure section, it is reheated and returns to the intermediate-pressure section through an interceptor valve or valves. After expanding through the intermediate and low-pressure elements, steam is condensed and feedwater returns to the boiler through the heating system in a conventional manner.

The only significant differences between this system and that of a corresponding nonreheat turbine are the additions of by-pass valve 5, interceptor valves 4 with their control G, and dump valve 6 with its control.

The purpose of the by-pass valve 5 is to avoid the possibility of overheating the low-pressure section during the starting cycle, and to by-pass the reheater when either water-washing or caustic-washing the turbine. In case the heat absorbed by the steam in passing through the reheater results in an excessively high temperature in the low-pressure blading, by-pass valve could be opened manually to permit part or all of the steam to flow directly from the high-pressure exhaust to the intermediate-pressure inlet.

In actual practice it has not been found necessary to open this by-pass valve during the starting cycle. The main reason for this is that the installations have been of the unit type, with one main and reheat boiler per turbine. As a result, the reheat temperature has been quite low during the starting cycle and no excessive exhaust temperature has been experienced.

This condition would not hold true if two boilers were supplied per turbine or if the station operated on the header system. While this has not been necessary or desirable on modern reheat turbines installed up to the present time, future conditions, particularly on the extremely large units, may dictate the need for more than one boiler, and in these cases the by-pass valve, and probably also desuperheating sprays in the reheat line, will be found necessary.

Interceptor valves 4 are installed to shut off the flow of steam to the intermediate-pressure element in case of sudden loss of load caused by the unit losing its electrical tie to the main system. Two valves in parallel are furnished, which arrangement reduces the physical size of the valves but, of greater importance, permits the testing of each valve separately while the unit remains in service carrying reduced load. This testing insures that the interceptor valves are in proper condition to close when called upon to do so by the auxiliary governor. A section through an interceptor valve is shown in Fig. 12.

As an added safeguard against sticking of these interceptor valves due to growth or deposits on the stems and bushings, the clearances between these stems and bushings have been made larger than normal. The valve stems are equipped to back-seat on the bushings in their wide-open positions. Since these valves are in their wide-open positions when the unit is on the line carrying load, this additional stem clearance provides safety against sticking without causing any additional leakage during the load-carrying period.

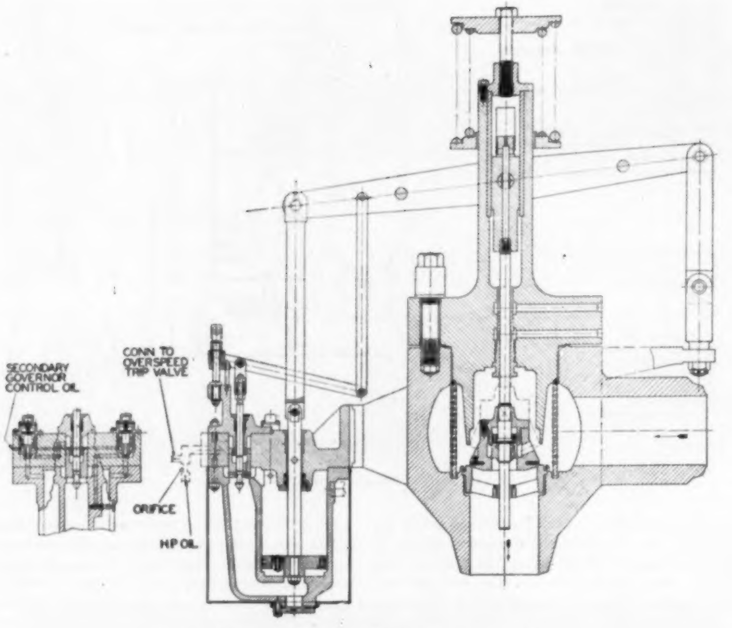


FIG. 12 SECTION THROUGH INTERCEPTOR VALVE

Dump valve 6 is provided on turbines of the type shown as arrangement B in Fig. 3, to dissipate the energy of the steam passing through the diaphragm seals when the interceptor valves have tripped closed. When valve 6 opens, steam will flow directly from the intermediate-pressure inlet to the condenser, by-passing the intermediate and low-pressure elements.

The use of an auxiliary governor, while not peculiar only to reheat turbines, is important from the standpoint of overspeeding in case of sudden loss of heavy loads. The main governor has normal speed regulation of from 4 to 6 per cent to suit system conditions. The auxiliary governor, which is set high and, consequently, out of range during normal operation, has a speed regulation of only $1^1/_2$ to 2 per cent. Therefore, when the speed has reached about 1 per cent above normal speed, the auxiliary governor responds very quickly to close the main governor valves and after the unit has accelerated to about 3 per cent above normal speed, it acts to trip the interceptor valves closed and to open the dump valves. In this way, overspeeds are kept below the setting of the overspeed trip even with sudden loss of full load.

### FUTURE OF REHEAT CYCLE

The future of the reheat cycle appears to be bright. There seems to be no likelihood that fuel costs will reduce and, if anything, they probably will go even higher than at present. Load factors also will continue at a high level until such time as installed capacity provides a more comfortable margin over the load demands.

These factors, together with the excellent operating records of modern reheat equipment, make the reheat cycle an attractive method of reducing operating costs and will tend to justify its use for a large percentage of future units.

### REFERENCES

"The 2000-Psi, 1050 F, and 1000 F Reheat Cycle at the Philip Sporn and Twin Branch Steam-Electric Stations," by Philip Sporn, Trans. ASME, vol. 70, 1948, pp. 287–294.

"Operating Experiences in Connection With Regenerative Reheat-Turbine Installations," by C. A. Robertson, Trans. ASME, vol. 71, 1949, pp. 673–683.

"Developments in Resuperheating in Steam Power Plants," by E. E. Harris and A. O. White, Trans. ASME, vol. 71, 1949, pp. 685–691.

"Reheating in Steam Turbines," by R. L. Reynolds, Trans. ASME, vol. 71, 1949, pp. 701–706.

"Steam Turbines for Resuperheat Cycle," by E. E. Parker, Trans. ASME, vol. 71, 1949, pp. 693–700.

"Steam-Generating Equipment for Resuperheating Cycles," by Martin Frisch, Trans. ASME, vol. 71, 1949, pp. 707–717.

"High-Pressure Boilers With Reheaters," by W. H. Rowand, A. E. Raynor, and F. X. Gilg, Trans. ASME, vol. 71, 1949, pp. 719–727.

"Modern Reheat Boilers," by W. S. Patterson, Trans. ASME, vol. 71, 1949, pp. 729–734.

"Symposium on the Reheat Cycle—Discussion," Trans. ASME, vol. 71, 1949, pp. 735–749.

"The Principles and Economics of the Reheat Cycle," by B. C. Mallory, *Electric Light and Power*, vol. 29, March, 1951, pp. 82–86 and 150.

"Some Factors Influencing the Economics of Reheat Installations," by R. W. Hartwell and H. A. Wagner, Trans. ASME, vol. 72, 1950, pp. 549–556.

"Selection of Steam Conditions for No. 4 Unit—Riverside Generating Station," by R. C. Dannettel and G. S. Harris, Trans. ASME, vol. 72, 1950, pp. 557–558.

"A Comparison of Costs of Reheat Versus Nonreheat for 100-Mw Units," by R. P. Moore, Trans. ASME, vol. 72, 1950, pp. 559–560.

"The Reheat Cycle—a Re-Evaluation," *Combustion*, vol. 21, June, 1950, pp. 38–40.

"The Reheat Turbine and Its Control," by H. R. Reese and O. N. Bryant, *Westinghouse Engineer*, vol. 11, March, 1951, pp. 62–67.

"Cost Analysis for 160-Mw Units Favors 1,800 Psi, 1,000 F Reheat," by G. R. Milne, *Electrical World*, vol. 135, February 26, 1951, pp. 89–92.

"The Trend Toward Reheat," by H. G. Ebdon, Midwest Power Conference, vol. 13, 1951, pp. 188–195.

# ADEQUACY *and* STANDARDS *of* ENGINEERING CURRICULA

### INTRODUCTION

THE aim of this report is to present at least in spirit the impressions of your committee concerning the adequacy of present-day engineering education and observations relating to what it estimates to be the standards employed by the engineering schools. Any attempt to appraise the present position of engineering education is destined to cause a certain amount of misunderstandings, due largely to the attitude of the reader at the time, and the impression the words convey in the climate provided by that attitude. Specific statements are often too limiting when taken literally, and generalizations are often too vague. An endeavor has been made, however, to present for consideration the committee's views on the present situation with the hope that, though brief and at times oversimplified and specific, the main observations will be accepted in their intended perspective.

### GROWTH OF ENGINEERING CURRICULA

Engineering education in America was not developed after a preconceived plan. It evolved in parallel with the needs of a growing country, a country engaged in the development of a vast industrialization. From the first it filled a practical need, and its design emanated largely from an evaluation of the professional requirements.

There were only a half-dozen schools of substantial merit by 1866. While the concept of engineering was the application of science to useful purposes, the educational program was heavily charged with the art of engineering practice. The better curricula had their roots in scientific studies. At that time, and for a generation to follow, a majority of practicing engineers were not engineering-college graduates; they were men who through experience, observation, and study, developed themselves to the point where they could cope with the technical problems of their time. Books began to appear and, with the development of laboratories for the teaching of principles (which, by the way, had been by 1870 in operation for 15 years in the Chemistry Department at the University of Michigan), gave strength to the program of the colleges in systematization of technical knowledge.

With the passage of the Morrill Act in 1862 the means and urge to found in each state a program in the mechanic arts for the aid of manufacturers were at hand. From 1870 to 1896 there was rapid expansion of the number of schools to 110 and the gradual formulation of the curriculum. By 1910 the forms of curricula in the older branches of the profession were pretty well standardized as to pattern. No elevating influences appeared to be at work on other than the newer curricula, such as chemical and metallurgical engineering, until the first world war.

Between the two world wars the engineering schools developed programs in electronics. Although these and the newer prewar programs were patterned after the "standard" form of curriculum, they nevertheless introduced new elements of strength in the increase of basic and applied science; and it was soon noticeable that they possessed more vitality and potential than the older programs. Yet most schools did little or nothing about these older curricula. Instead, most colleges of engineering were preoccupied with the development of various offerings to cover students interested in the fringe areas: Those who would be contiguous to, but not really a part of, engineering itself. While these programs served a useful need, their inclusion in one guise or other as *engineering* programs was a clear departure from the earlier concepts of professional training.

During the entire period from the earliest days to the second world war, there was not an established position for the technical school offering a program that would be post high school, but with more emphasis on high-grade craftsmanship training than on professional education. Many of the earliest schools of this type gradually expanded to four-year programs. A few, having a clear view of the need and great importance of such training, have held to their convictions and have developed strong programs with notable results.

### CRITICAL EVALUATION OF FACTORS IN ENGINEERING-COLLEGE DEVELOPMENT

As one examines the history of the growth of engineering colleges and their development, certain features thereof are especially evident. The very rapid expansion in both number and size of schools left little choice than to imitate the more successful. Not so obvious was an underlying situation that many of the new schools had only a dim concept of their objective in service to the profession. There was at work in the same setting the notion of spreading higher education for all, a factor that is restrictive of high standards. As schools grow, the pressure for staff expansion led to recruiting by the simple process of keeping on recent graduates, and then allowing them to do their graduate work, if any, while teaching. In this way, there was a subtle influence of continuity of curriculum with little urge for re-evaluation or vitality of concept of objectives. A standard pattern was achieved, not so much by deliberative process as by a sort of combination of gravitation and inertia.

Coupled with these influences was the circumstance of ever-pressing financial problems in young and growing schools, and the consequent limit on salary scales. Not a few administrators found themselves unable to pay salaries that would command talent already developed, and in some cases they could do little more than employ something less than the top of the currently graduating class—"temporarily." The deadening effect of obsolescence upon laboratory equipment, some of it hard-won after years of waiting and planning, had its part in gradual "standardization" through the lack of means to preserve a dynamic program.

Over the years, the number of practicing engineers without engineering-college education was gradually diminishing. This was due in part to the availability of engineering schools, and to an increasing extent to the complicated nature of the engineering function. Between the world wars, with the introduction in many schools of programs with greatly reduced scientific and technical content, yet calling the output "engineers," there arose increasing confusion as to what constituted engineering and what characterized engineers. Accountants,

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Report of a Special Committee on Adequacy and Standards of Engineering Education of Engineers' Council for Professional Development, presented at the 19th annual meeting, Boston, Mass., Oct. 19–20, 1951. Members of Committee: C. S. Crouse, L. F. Grant, M. D. Hooven, S. C. Hollister, *Chairman*.

for example, and graduates of business courses, and others, who had enterprise to pose as consultants on managerial matters, called themselves management or industrial engineers. Graduates of such courses could perform but elementary engineering functions. There can be no question that these courses of reduced technical content were an aid to certain persons; the serious doubt was whether they should have been considered *engineering* courses.

From the earliest days the program of engineering education was limited to four years, in parallel with the usual undergraduate college program. A very few schools added one or two years, with an additional degree. During the period of development and growth, the medical, legal, and architectural professions have extended their length of program to meet their particular objectives. It is significant that these developments had no effect upon the engineering professional program and that in consequence, with conspicuously few exceptions, the engineering curricula have remained four years in length, beginning immediately after high school.

Meantime, the fields of sciences, without exception, have been obliged to extend their programs through the addition of graduate work. Today, no scientist is considered adequately trained without the doctor's degree. Whether graduate work is an appropriate program for the professional engineer is one of the questions dealt with by your committee.

Probably the most significant single characteristic of the engineering educational field is that it has no generally accepted professional objective as a goal for the educational program. There is general agreement respecting the form of the curriculum. It is difficult to detect differences in programs between schools simply by comparison of curricula. The major differences lie in the depth of instruction and in the objective of each institution in respect of the professional outlook to be achieved. There exists today a spectrum of objectives ranging from highly professional programs supported by strong science backgrounds to vocational programs in which only a moderate amount of science is included.

It is possible to divide the subjects included in any engineering curriculum into five groups, as follows:

1 Basic science (mathematics, physics, chemistry, biology).
2 Applied science (mechanics, thermodynamics, fluid mechanics, geology, circuit theory, properties of engineering materials, etc.).
3 Applied engineering (for example, internal-combustion engines, structures, machine design, industrial electronics, foundry technology, plant design, etc.).
4 Administrative and managerial (cost control, industrial organization, labor relations, etc.).
5 General (liberal courses, to provide a general educational background). Curricula may vary in the emphasis placed upon group, and in the extent of dominance of one group over the others.

Historically, applied-engineering courses dominated the curriculum in the early years. Gradually the pattern of basic science courses was evolved and generally included. Shop courses were reduced to a minimum. From 1885 until the first world war, mathematics was stabilized in the older curricula, terminating with the calculus. Since then only a few schools have carried the subject further in civil, chemical, mining, and mechanical engineering, while many schools have required additional mathematics in electrical engineering. Except in chemical engineering, and in some cases of mining engineering, the amount of chemistry required has been limited to general inorganic chemistry.

The time requirement in physics has remained nearly constant in most curricula since about 1885. Generally, the classical approach to physics instruction has been followed. The depth has varied with the amount of mathematics available at each stage. The calculus, while standard in all curricula, is not employed to the same degree in physics. In civil and mechanical engineering the amount of physics is limited to one year in most schools; and in many the same limit is found in electrical and chemical engineering. Generally, however, the approach from the point of view of atomic and molecular structure is needed but wanting.

The time devoted to mechanics is similar in nearly all schools. The variation in effectiveness of the course is not due to allotted time so much as to the depth of instruction. For many years it was the custom to minimize the use of the calculus in this subject. The development of stronger texts over the last two decades has greatly improved the effectiveness of the instruction; however, there is still much variation in depth of the requirements placed on the student. There may be said to be a definite upswing in the quality of instruction in mechanics, although this is not believed to be general. In mechanical engineering, for example, vibrations and their consequences are treated in only a few schools. In fact, in civil engineering, dynamics is regarded as being unnecessary, yet fatigue is becoming more important in structural design.

Hydraulics used to be taught from the empirical standpoint. Between the two wars there was pressure, emanating from the aeronautics field, for instruction in fluid mechanics. Some schools dealt sincerely with this proposed change; but many others simply changed the course name from hydraulics to fluid mechanics.

While in chemical engineering thermodynamics has been taught with regard to interaction between the thermal and chemical circumstances involved, there has been little attention given to such matters in mechanical engineering. Today, a chemical engineer is not infrequently better trained for fundamental work in heat power than the mechanical engineer, in whose field heat power lies.

During the past several decades the instruction relating to engineering materials has developed into a program reciting a general discussion of their manufacture, and their mechanical properties as revealed by standard acceptance tests. The metallurgical aspects are lightly touched upon if at all. Instances can be found of the absence of a course in materials in electrical engineering, while in other cases in the same field students get the notion that such instruction together with the mechanics of materials is largely unnecessary for an electrical engineer, especially in communications.

### FACTORS OF MAJOR SIGNIFICANCE IN CURRICULUM DESIGN

Many perplexing problems stem from the fact that the engineering college, in preparing students for professional work that will reach maximum culmination twenty or more years hence, must evaluate hazily discernible future events. It certainly appears desirable that a major stress be placed upon those elements of the curriculum that will give the most continuous and lasting support to the graduate's professional life. Apart from the teaching of the professional attitude toward engineering and the instilling of the engineering and scientific method of attack upon problems, there are certain specific features of the curriculum that can be accepted as most essential.

The first of these has to do with courses least likely to obsolesce. While it is necessary to give a certain amount of instruction relating to the present state of the art, it is certain that the present state will change, and hence that time given to such courses is not time devoted to a subject of sustaining value. Sifting back through the curriculum, it seems clear that instruction in the basic sciences, if taught in a manner such that knowledge of them makes available working tools, contributes the

most sustaining part of the curriculum. Among these basic sciences, the greatest potential for future development in science and technology is to be found in mathematics. An engineer with a good knowledge of mathematics is in a position to read with understanding and profit in physics and chemistry. Likewise, as his interest and need may expand, he may read further in the applied sciences, such as mechanics, elastic stability, advanced thermodynamics, or fluid mechanics. Similarly, new applications of sciences to engineering situations may be understood and assimilated. Thus mathematics not only becomes the support of the group of courses that will obsolesce least; it becomes the means of further technical growth as befits the graduate's interest and need. Building into the program in this and other means for further technical self-development of the individual after graduation is the second most important feature of a well-designed curriculum.

The third feature that impresses your committee as of ranking importance has to do with the way in which the applied courses are related to those in basic and applied science. Two distinct approaches are discernible in present practices: one utilizes the engineering situations provided in the applied courses to illustrate the manner of employing the sciences in engineering work, while the other makes the applied courses the goal of the curriculum with the minimum of application of the sciences. The former builds into the student a power of analysis and resolution in engineering situations that permits a wide range of application. The latter tends toward the achievement of a series of skills intended to equip the student for specific jobs immediately upon and soon after graduation. The first is professional preparation, the second vocational training. What is involved is not alone the way in which individual courses are presented; it especially relates to the prevailing concept of the function of the whole curriculum.

Following the concept that the differentiating characteristic of the engineering function is the ability to utilize the sciences for the creative process of design and development of useful apparatus, structures, or other works, the program should aim at the development and expansion of the imaginative process of creative thought. Engineering educational processes are most commonly of the problem type, requiring but a single answer, with no latitude for judgment, and no imaginativeness beyond the visualization of the circumstance of the problem. Programs in architecture far surpass those in engineering in this respect. We tend toward producing a literal-mindedness that is not compatible with creative imagination.

The foregoing discussion has been in broad terms. It is believed that quantitative specifications for engineering curricula are not adequate as guides to curriculum planning because they tend toward regimentation, toward fixation, and toward eventual stagnation of awareness of the professional needs. The content in each of the five categories enumerated must be determined in terms of the need of the graduate two or three decades ahead, not in specific detail but in sound skeletal preparation, with most of the details to be filled in through further study and acquisition of experience in the field. The skeletal program must be strong and of sufficient stature to support and sustain the growing professional career.

Engineering is both a science and an art. A balance between both is desirable. The tendency has been to emphasize the art unduly. The "engineering approach" can be presented in the manner in which science is brought to bear on an engineering situation. Much of the art can better be acquired in the field. Industry is coming quite generally to recognize this arrangement as desirable for its needs.

### SUGGESTED PROGRAM

The quality of engineering curricula varies over a wide range, from highly developed professional programs to those having a predominantly vocational content. The foregoing discussion relates especially to the middle and lower portion of the range. Accrediting procedures relate almost entirely to the minimum standards, and tend to breed complacency among those schools that just barely satisfy such a standard. While accrediting must be maintained as a part of the licensing procedure, it cannot be expected that accrediting of itself will achieve the improvement of schools that satisfy the minimum requirements—unless two or more classes of schools were established and accrediting set up for each class. Your committee believes that such a scheme would neither be welcome nor desirable. Rather it believes that the engineering educational field has a great opportunity to study itself, with the object of finding ways at all levels to improve its service to the profession.

One way to make such a study is to set up an agency that would study and report its findings, as was done by the Society for the Promotion of Engineering Education in the Twenties, under the late W. E. Wickenden. Such a procedure has the effect of isolating the study and removing it from the schools themselves. The conclusions of Wickenden, written in 1929, are to be found in Appendix I[1] of this report; and your committee is struck with the potency of the statement to today's situation, and the extent of the failure of the schools to implement much of the recommendations. Other statements, appearing since the Wickenden report and bearing upon the same subject, are given in the remaining appendixes. From these it seems clear to your committee that what is now needed is active study and self-appraisal by the schools themselves, looking toward implementation of recommendations already made.

In some quarters the suggestion has been made that an overlay of graduate work is the answer to a need for stronger science content in the curriculum, and to a higher total level of achievement. Your committee believes that the basic program in engineering leading to the first degree in the field should be of a quality to suffice for the professional need of perhaps eighty per cent of the graduates, and that truly graduate work should be reserved for the remaining few having special competence. The responsibility for support of the profession, it is believed, must rest chiefly upon the adequacy of the undergraduate program.

The great pressure upon the engineering schools to provide general education in addition to an increased scientific and technical training brings them constantly face to face with the limitation in time imposed by the conventional curriculum. It is perhaps time that this problem was approached in terms of total need; and then the time required to achieve this need be measured beginning with the preparation now available from the secondary schools. For many years the approach has been to see what can be given within the four-year framework, with the result of overcrowding the program and with a general shifting first in one direction and then another without total gain in achievement. Other professions have had to face this issue. If engineering maintains professional stature, it will have to organize accordingly. Some have suggested a pre-engineering period in which the high-school preparation may, if necessary, be augmented to a desired level before beginning engineering study.

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[1] Not included in this printing. The complete report has five appendixes: (1) "The American Scene," by W. E. Wickenden, director, Investigation of Engineering Education, Society for the Promotion of Engineering Education, vol. 1, 1929, p. 1000; (2) "Engineering and Social Progress," by Karl T. Compton, Proceedings, SPEE, vol. 47, 1939, p. 8; (3) "Atomic Engineering," by Theodore von Kármán, MECHANICAL ENGINEERING, October, 1945, p. 672; (4) "Tomorrow's Engineers," by J. R. Van Pelt, Proceedings, SPEE, vol. 55, 1948, p. 168; "Present-Day Engineering and Applied Science," Report of Panel on the McKay Bequest, Harvard University, 1950, p. 7.

There has been some discussion of the list of degrees granted in engineering. There is a gradual tendency to drop the professional degrees of C.E., M.E., etc., awarded after a suitable interval of practical experience and the submission of an acceptable thesis. If the professional degrees became generally available for work in course, they could then be used to designate the longer programs that are now under way, whether they be one-degree or two-degree programs.

Finally, it becomes clear that there is going to be a shortage of engineers for many years to come. At such a time, in the national interest, it is of paramount importance that the best possible education in engineering be provided by our schools. Each man is going to be called upon to cover a greater range than heretofore, if the engineering needs are to be met. Every school should devote itself to ways of substantial improvement of its program, to the end that its graduates will meet the responsibilities being placed upon them.

## Less Familiar Metals of Commercial Importance

(*Continued from page 8*)

increased to 45,000 lb. Recently quoted prices were $1.75 per lb for tellurium and $3 per lb for selenium.

The most valuable characteristic of selenium is its change in electrical conductivity when exposed to light. Selenium cells (electric eyes) are in common technical use for counting, scanning, or sorting machines, safety devices, and light meters. Selenium is used in electric rectifiers. It is applied to glasses for decolorizing as well as for obtaining yellow and red colors.

Selenium has been proposed as a substitute for sulphur in an endless number of applications, but few of these appear to be of technical significance. In some organic dyes, sulphur replacement by selenium is said to increase brightness. The same is true for some pigments. Both selenium and tellurium are employed in vulcanizing rubber in the place of, or in addition to, sulphur. The resulting products show greater toughness and higher resistance to abrasion. Tellurium is used in toning of photographic prints.

The principal metallurgical application of both selenium and tellurium is in copper alloys where addition of 0.5–0.6 per cent of either element renders the metals free-cutting and allows their machining at high speed. One-quarter per cent selenium is added to low-expansion alloys like Invar and to stainless steels for the same purpose. It is also used as a special addition to corrosion-resistant castings—for instance, to a type CF alloy of 19 per cent chromium and 9 per cent nickel to promote machinability and soundness. Tellurium, in amounts of less than 0.1 per cent, improves the work hardenability of lead and increases its recrystallization temperature. Even small amounts (0.05 per cent) improve creep strength and work-hardening of tin.

For both elements, selenium and tellurium, the potential supply as by-products exceeds the demand, and new applications would be welcome.

### RHENIUM

At present rhenium is of little or no technical application, but because of its unusual qualities, this situation might change in the years to come. Rhenium looks like silver, but its density, 20 grams per cu cm, exceeds that of gold and approaches that of platinum. It is of extreme corrosion resistance. Its melting point of 3170 C is exceeded only by tungsten.

Molybdenum smelter flue dust in Arizona has been the source for the small amounts (100 lb or so) made in this country. The present price lies between $5 and $10 per gram. A number of patent claims have been made for rhenium, in hard acid-resistant alloys with W, Mo, Cr, Ta, and with the platinum group. It has been used instead of the platinum metals in pen points and similar applications. Because of its high melting point it has been proposed for high-temperature thermocouples and for lamp filaments, electric contacts, and the like.

Discoveries of rhenium in titanium ores are of potential interest. There is no doubt that an increased or more concentrated supply of the metal soon would be followed by its technical application.

### CONCLUSION

This review has been a rather condensed and necessarily cursory trip through the wide field of the technical application of the less common metals. It is hoped that the reader will be impressed by the variety of their uses and will realize that modern metallurgy is able to furnish specific materials for almost any specific requirements.

## Pressure-Operated Furnaces

IN a report on the status of the new method of operating iron blast furnaces under pressure, Dr. B. S. Old, vice-president of Arthur D. Little, Inc., the Cambridge, Mass., engineering firm which originated the process, revealed that all six of the large blast furnaces now under construction in the United States will operate under pressure and that five old furnaces are being converted to pressure, in addition to eight now operating in the United States and one in England. He estimated that on the basis of experience with furnaces now operating, these furnaces altogether would produce at least 1,000,000 tons more pig iron each year than if operated conventionally. More pig iron is urgently needed to supply the expanded steelmaking capacity now operating and under construction.

In operating a furnace under pressure the exit-gas system is throttled so that pressure at the top of the furnace builds up; pressures up to about 12 lb above normal atmospheric pressure are now used. With the system throttled down, the air blown in the bottom of the furnace moves through more slowly, so that it is possible to blow a greater weight of the compressed air through without blowing valuable ore out of the furnace. The availability of more air permits the burning of more coke per day and thus the smelting of more iron per day.

The first pressure furnace started regular operation in 1946. This was the Cleveland (Ohio) No. 5 furnace of Republic Steel Corporation which worked with Arthur D. Little, Inc., in developing the equipment and procedures for pressure operation. Republic Steel recently announced that this furnace had set a company record for output, with 48,005 tons of iron produced in September, 1951. The average daily output was 1600 tons, compared with 1400 expected under conventional operation when the furnace was rebuilt. The record was made despite the fact that the furnace was processing relatively low-grade ore, which normally reduces capacity. In turning out this much iron the furnace set a world record for "wind" blown, with a daily average of 6340 tons of air blown into the furnace. Republic has converted 45 per cent of its total blast-furnace capacity to pressure operation.

The Cleveland No. 5 furnace has a 28-ft hearth (diameter at the bottom); furnaces with a hearth diameter of 27 ft or more are considered "large," Dr. Old said. The six large pressure furnaces now building will have average output of at least 1600 tons a day, he added, and the older converted furnaces will be increased in capacity from an average of 1250 to 1400 per day.

# BRIEFING THE RECORD

## Abstracts and Comments Based on Current Periodicals and Events

*J. J. Jaklitsch, Jr., Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

## Radioactive Fission Products

A POTENTIAL large-scale demand for fission products exists in industry, but many technical and economic problems must be solved before promising new uses for these by-products of the atomic-energy program can develop. This was the broad finding and conclusion of Stanford Research Institute of Stanford, Calif., from a recent technoeconomic survey of industrial uses of radioactive fission products conducted for the United States Atomic Energy Commission and announced in a report recently published by the Institute.

Millions of curies of radioactivity are contained in the process wastes left over from the production of plutonium in the AEC's nuclear reactors. Of no usefulness for industrial or explosive power or as a heat source, these fission products are known to be a potential source of large quantities of low-cost radiation. Refinement and concentration of the gross fission products, now stored at AEC installations, will undoubtedly be necessary to make them suitable for industrial purposes, the SRI study indicates.

Promising industrial applications for fission products are to be found in various stages of technological development, according to the report. One table sets forth in summary form the approximate state of technological development of selected large-scale potential industrial uses, the fission products required, the maximum value-in-use or competitive price, the size of the market, and the nature of the competition.

Present commercially feasible industrial uses include the activation of phosphors for self-luminescent signs and markers, static eliminators for a variety of industrial processes, the reduction of starting-voltage requirements in fluorescent light tubes, and in process-control instruments which incorporate a source of radiation.

Possible future uses for fission products, where the technology and desirability of use will require at least two to five years for development, include industrial radiography, cold sterilization of drugs and foods, and portable low-level power sources. In the highly speculative area where basic technical knowledge is lacking, possibilities exist for uses in radiation chemistry and flame propagation.

The marketing study emphasizes that the possible industrial advantage in use of fission products lies in their potential ability to produce certain types of radiation at less cost or in more convenient forms than presently available sources. Fission product gamma rays would be considerably cheaper for similar uses than comparable x rays from machines and would perform functions that cannot be accomplished by cathode rays from existing machines because gamma rays will penetrate through much greater thicknesses of material.

Where radiation-dosage requirements are small and numerous, beta-emitting fission products are considered more practical than machine sources of cathode rays. The only competition to fission products in such application is from radioisotopes specifically produced for these purposes.

The magnitude of demand for fission products is expected to be primarily a function of price. The report states that it appears that a price of $1 to $2 per curie would be low enough to assure a market in the order of hundreds of thousands or even a few million curies a year. Although a price of $50 to $100 per curie would reduce the potential demand to a level of tens of thousands a year, when thousand-curie quantities of certain fission products are made available at this price, there will be an industrial demand for them.

The technological and marketing problems confronting the Commission in making fission products available to industry are difficult but not insurmountable, according to the report. Reviewed are technical problems involved in the design of processing plants to separate the fission products; in engineering the sources of radioactivity into a form suitable for various purposes; and in supplying fundamental knowledge on which to base development of industrial applications. Marketing problems outlined in the study cover such matters as pricing policy, promotional effort, engineering services, mechanics of distribution, personnel training, patent policy, inspection and reports policy, and safety regulation and education.

There are definite signs that both industry and the Commission are beginning to move ahead with research programs aimed at developing large-scale uses for fission products, says the report. The announcement last July that Brookhaven National Laboratory has a 1000-curie source available for experimental use by industry has met with immediate industrial

### How to Obtain Further Information on "Briefing the Record" Items

**MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.**

**For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.**

acceptance. The Commission is sponsoring research programs at Brookhaven, Massachusetts Institute of Technology, the University of Michigan, and Yale, Columbia, and Syracuse Universities, aimed at assisting industry in this field. A number of prominent industrial concerns have expressed interest in pilot-plant operations, especially in the field of radiation sterilization, as suitable fission products become available.

To encourage further study by industry of possibilities of use, the Commission has authorized the Institute to make the report available at cost. Copies of the report may be obtained for $1.50 from Project 361, Stanford Research Institute, Stanford, Calif.

# Aircraft Nuclear Propulsion

THE principles underlying nuclear-powered flight, some possible methods of achieving it, and some problems which are involved, were discussed by Dr. Miles C. Leverett of the Aircraft Nuclear Propulsion Project, General Electric Company, Oak Ridge, Tenn., before a recent meeting of the Institute of the Aeronautical Sciences in Chicago, Ill.

Dr. Leverett pointed out that one pound of uranium-235 will liberate heat on undergoing fission equivalent to the energy liberated by burning 1,700,000 lb of gasoline.

Although the basic superiority of nuclear fuel over chemical fuel is thus superficially stated as a simple ratio of 1.7 million to 1, the implications and complications of this fact are extremely varied and far-reaching. For example, some of the implications he listed were as follows: A nuclear aircraft could encircle the globe many times without stopping, although this particular maneuver would be more dramatic than useful. It could fly entirely around the world at local midnight, accomplishing the entire circuit in darkness and with the lower vulnerability which night flying confers. Careful husbanding of fuel, programming of flight speed and altitude, and closely timed flight plans would become unnecessary in a nuclear-powered airplane. Such an airplane could fly at its maximum speed and at any altitude over its operating range for all or any part of its mission and still be perfectly sure of having enough fuel to return to its home base by any route whatever. A nuclear-powered aircraft could possibly stay aloft for many days. It would be limited only by the freedom of the aircraft and power plant from breakdown and by the ability of the crew to endure long hours of flight and exposure to nuclear radiation. It is clear that many missions which are impossible for chemical aircraft would be possible with nuclear-powered aircraft.

### PROPULSION MACHINERY AND REACTOR

Many proposals for a power plant have been made, he said, including turbine-driven propellers, a turbojet in which the reactor takes the place of combustion chambers, and a ramjet engine with similar substitution of a reactor for combustion apparatus.

In all cases, except that of the ramjet and other direct air cycles, it is required that heat be transported in a coolant from the reactor to the propulsion machinery.

The design of the reactor will be greatly influenced by the coolant chosen. However, the basic principle upon which the reactor operates is the same regardless of the coolant. This principle is as follows: The reactor may be thought of as a more or less cylindrical body throughout which a fissionable material such as uranium-235 or plutonium-239 is distributed. The reactor also contains passages for the flow of the coolant through it necessary for the removal of the heat and also usually contains a material which is called a moderator. Typical moderators are graphite, ordinary water, heavy water, beryllium, and beryllium oxide. The reaction starts with the capture of a neutron by a nucleus of, say, uranium-235. Since neutrons are present in small concentration in the atmosphere everywhere, this serves to start the reaction. Immediately after capture of the neutron the U-235 nucleus disintegrates with the liberation of two to three neutrons and 2 atomic nuclei (fission fragments) both smaller than the original nucleus. Most of the energy of fission is carried off by the fission fragments; this energy is imported to the material into which they are cast and appears as heat. Gamma rays and beta rays also are given off in the fission process.

The two to three neutrons given off are ejected into the body of the reactor and may undergo one of three different fates. (1) They may escape from the reactor entirely and be captured outside it by some parasitic nucleus in the structure of the shield or its surroundings. (2) They may be captured by some of the nonfissionable materials in the reactor itself. (3) They may be captured in another U-235 nucleus, following which additional neutrons will be given off. If we can design the reactor so that as many as about 40 per cent of the neutrons given off in fission are captured in other fissionable nuclei in such a way as to cause fission there, the reaction will continue indefinitely until the fissionable nuclei are used up, he said.

The basic problem of reactor design is to reduce to acceptably low values the first two methods of loss of neutrons just mentioned.

### SHIELD

A substantial portion of the energy of a reactor appears as kinetic energy of the neutrons and as ionizing radiation such as gamma rays and beta rays. The neutrons and gamma rays, if allowed to escape with complete freedom from the reactor, Dr. Leverett indicated, would make it necessary for human beings to stay at a distance of more than a mile from a high-powered reactor while in operation. Moreover, since the fission products themselves are radioactive and continue to emit gamma rays even after the chain reaction has been stopped, it would not be possible to approach the reactor very much closer than this even after it had been shut down. It is clear that a shield must be provided.

### PROBLEMS OF NUCLEAR-POWERED AIRCRAFT

Some of the problems which confront the designer of a nuclear-powered aircraft include the following:

*Shield Weight.* The shield will be the heaviest single object aboard the aircraft. Early published estimates of shield weight placed the minimum shield at 50 to 100 tons, without any provisions for removal of heat. From this it is evident that a large aircraft will be required to carry a weight of this magnitude even though the aircraft need carry little or no chemical fuel. To a first approximation one may balance off the weight of the shield against the weight of the fuel load which would be carried in the large modern aircraft, since the shield and the reactor which it contains essentially replace the fuel load. The fuel loads of modern aircraft range up to the neighborhood of 75 tons or more. If the early estimates of shield weight referred to are anywhere near correct, it is evident that the weight of the shield plus the reactor is not grossly different from that of the fuel which can be carried in a large conventional aircraft. However, every effort must be made to keep down the weight of the shield and the reactor. One obvious way to do this is to make the reactor small so that the shielded volume is kept small. This in turn restricts the amount of cross-sectional free-flow area through which coolant may pass through the reactor and increases the pressure drop. Moreover, as the reactor diameter decreases, it usually is found that more fissionable material is required. This is undesirable. There is therefore a

balance to be struck between the benefit of small shield weights resulting from decreased reactor size on the one hand, and the disadvantages resulting therefrom in smaller free-flow area for coolant flow and larger fissionable-material investment required.

*Balance and Structures.* The existence of a large concentrated weight, such as the shield and the reactor at one point in an aircraft, makes it necessary to redesign the structure of the aircraft to accommodate this weight.

*Large Landing Weight.* The fact that only a small amount of the fuel is consumed in flight means that the gross weight of a nuclear aircraft will be approximately the same on landing as on take-off. First, the landing gear must be made strong enough to take the higher gross landing weight. Second, the landing speed is increased and there may be a change in landing attitude which possibly could require changes in the landing gear, or in tail clearance-angle requirements.

*Heat Transfer.* The essence of a nuclear power plant is the transfer of heat from the reactor to the propulsion machinery. The requirements for small-size and high power density placed upon the aircraft reactor push the heat-transfer designer to the limit of his knowledge. He must avoid hot spots in the flow system, he must have good flow distribution, and he must know exactly how the power is distributed in the reactor so that he can supply the right amount of coolant to each part of it.

*Materials.* One of the most important problems in reactor technology today, Dr. Leverett emphasized, is the finding and development of materials adequate for use in reactors which are proposed for production of power in one form or another. The combined effects of high temperature, corrosion by various coolants, radiation damage, thermal stresses, and mechanical stresses can be extremely serious in some cases. The aircraft reactor presents these problems to an unusual and critical degree. For example, a difference of 100 F in permissible maximum reactor temperature can easily produce a 15 per cent difference in thrust output of the power plant. High-temperature materials are therefore a prime necessity. A corrosion-resistant coating on the reactor heat-transfer surfaces a few thousandths of an inch thick may double the critical mass. A brazing alloy containing a few per cent boron (a strong neutron absorber) may put so much boron into the reactor that it cannot be made to go critical, and this particular alloy may therefore be entirely unusable. An alloy high in nickel may have good corrosion and high-temperature strength properties for use as reactor structure, but be so strong a neutron absorber as to be substituted by another alloy of lower nickel content and poorer corrosion and strength properties. The finding of materials adequate to withstand these conditions is a challenge worthy of the best metallurgist, ceramist, or chemist.

#### OUTLOOK

In many respects, Dr. Leverett said, the propulsion of aircraft is an ideal use for nuclear energy. Here to a higher extent than in any other application the advantages of a highly concentrated source of heat can be used to good result. Although the goal of producing a nuclear-powered aircraft is an admittedly ambitious one, it is only such high-performance premium uses of energy which can today justify the consumption of as rare a resource as uranium-235 or plutonium-239. Moreover, it is inescapable that a development of this type has great military significance.

In recent months, he states, the government has announced that the nuclear-aircraft program is entering a new phase. In this new phase the Aircraft Gas Turbine Department of the General Electric Company has been given the responsibility for the propulsion system and the Consolidated Vultee Aircraft Corporation is to supply the airframe.

Dr. Leverett indicated that he believes our efforts to fly an aircraft on nuclear power will be successful.

# Aircraft Gas-Turbine Research

NEW tools and techniques devised to carry on the scientific research on current problems of aircraft propulsion were revealed to key executives and engineering personnel in the military services and industry during the recent 1951 Biennial Inspection of the NACA Lewis Flight Propulsion Laboratory in Cleveland, Ohio. There are many problems under intensive study at the Lewis Laboratory and the following brief discussions of some of the demonstrations witnessed at this year's inspection are representative segments of NACA's comprehensive program of propulsion research.

#### COMPRESSOR BLADE VIBRATION

Lewis research engineers pointed out, for example, that an important cause of failure of rotating blades, especially in the axial-flow compressor of a turbojet engine is vibration and that one of the most important sources of vibration is stalling flutter, a condition in which the compressor blades vibrate as reeds in a strong wind.

Compressor blades normally operate at very high angles of attack, near the point of aerodynamic breakdown, or stalling. Investigation of one engine showed that the critical velocity which starts this stalling was actually being encountered, with a resulting high rate of blade failures. Reduction of the angle of attack made the appearance of stalling flutter less likely. This was accomplished merely by twisting the guide vanes in front of the compressor stage where the blades were foiling. No loss in efficiency of the compressor occurred as a result of the change in guide-vane angle.

A second remedy, it was learned, has been introduction of enough damping action in the blade mount to overcome the aerodynamic excitation of the wind stream. In the conventional method of blade mounting, when the engine is operating, the centrifugal pull on a blade is so great that it is effectively locked in the mount and it is difficult to introduce damping. If a thin film of dry lubricant is introduced between the blade and the mount, then the locking action is minimized and damping can be effectively achieved. Use of this technique, when applied to compressor blades, reduced the stress amplitude to about one third its former magnitude.

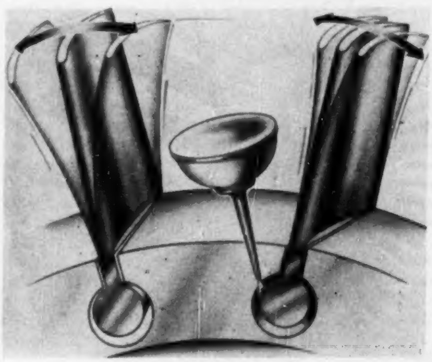

FIG. 1 COMPRESSOR BLADE VIBRATION MINIMIZED BY USE OF DRY LUBRICANT

COMPRESSOR TEST BLADE FABRICATION

In compressor research, although the quantity of any single design may be small, the total number of experimental blades required is large.

To provide such quantities of experimental blades, development of special equipment has been necessary at Lewis. This is in addition to use of commercially available machine-shop equipment. By striving always to minimize the amount of tooling necessary to reproduce a new blade shape, it has been possible to speed the production processes whereas costs of individual blades have been reduced.

During the past year considerable improvement has been made in the method of reproducing an airfoil section, it was revealed. Working directly from a greatly magnified drawing of such a section, a specially developed machine quickly reproduces the desired section in thin metal. As soon as the several sections making up a blade have been machined in this manner, they are stacked in order and become the master template for the entire blade.

A further advance in the technique eliminates the need for making templates. In a new device that enables this production short cut, mathematical information concerning the design of the blade desired is fed into an "electronic brain" which then transmits impulses into machining equipment that cuts the blade shape out of metal. Only recently put into operation, the new development already has been used to cut a number of airfoil sections.

TURBINE BLADE COOLING

Of all the complex and expensive rotating parts that go into a jet engine, the turbine blades and wheels are subjected to the most severe combination of high centrifugal force, hot corrosion, and extreme operating temperatures, the engineers said.

In the face of inadequate supplies and reserves of vital alloy metals, such as cobalt, chromium, and nickel, air cooling of gas turbines appears to be the most practicable method for turbojet engines at this time. In present practice, more than half the air that passes from the engine compressor through the combustion chambers is not burned. Instead, it is used to dilute the burning gases to reduce their temperature to the limits imposed by the structural members of the engine, especially in the turbine. A logical solution is to use a small part of this excess air

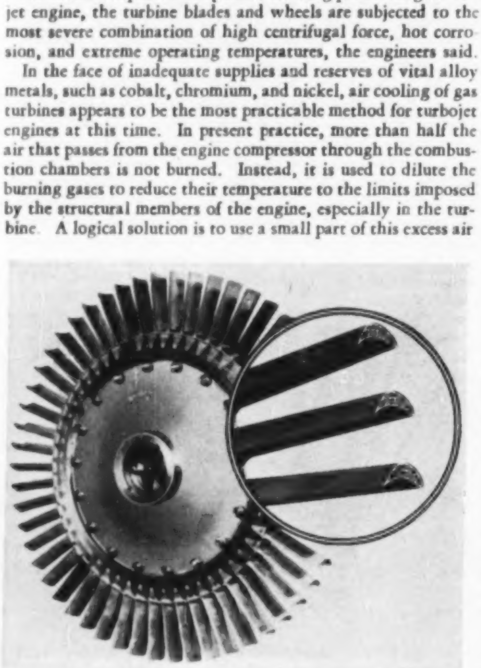

FIG. 2 AIR-COOLED BLADES INSTALLED ON TEST TURBINE WHEEL

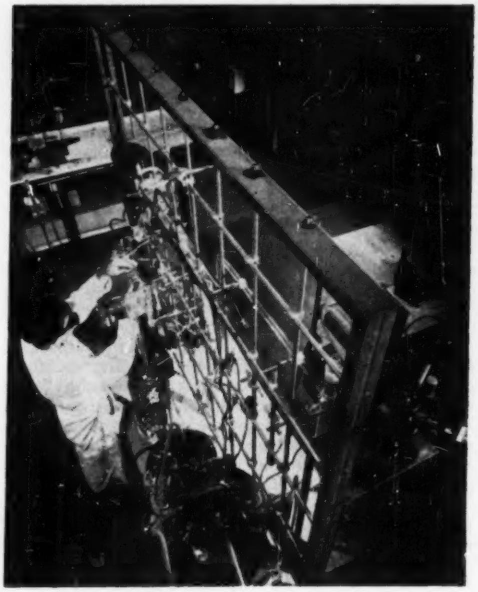

FIG. 3 SCIENTIST STUDIES MATERIALS BEHAVIOR AT 5000 F

to cool the turbine parts, which in turn will allow more of the air in the combustion chambers to be burned, increasing both gas temperature and power output.

At the end of World War II, the best available air-cooled blade design was a simple hollow shell cooled by air bled from the main engine compressor, through the turbine wheel, but the air flow required was prohibitive. Fundamental heat-transfer studies pointed to the need for increasing the surface area within the blades to be cooled, and the most practicable means for accomplishing this seems to be packing the coolant cavity with small tubes.

The result is a blade relatively easy to fabricate and with satisfactory cooling. Other possibilities suitable for quantity production now are being explored. If the stator blades are twisted, it is aerodynamically satisfactory for the turbine blades to be straight, which also eases the production problem.

From temperature reductions already obtained by air cooling, it now appears possible to build turbine wheels and blades of steels more plentiful and cheaper than the high-temperature alloys now used.

MATERIALS RESEARCH

Another approach directed at strategic-materials conservation by NACA is the use of materials containing ceramics. Although ceramics possess excellent strength at high temperatures, in their pure form they lack thermal-shock resistance and shatter under sudden temperature changes. Consequently, in this form they cannot be readily used in turbine blades because of the severe thermal shocks which are experienced.

It was reasoned, however, that if blades could be made of a mixture of a ceramic and a metal, it might be possible to combine the good qualities, the strength of the ceramic at high temperatures with the thermal-shock resistance of the metal. After preliminary investigations had indicated that such

ceramals, combinations of ceramic and metals, might have adequate thermal-shock resistance for turbine-blade application, intensive work has begun to find means of actually fabricating and using such ceramal blades.

A powder-metallurgy technique, sintering, is used to fuse the ceramic and metallic materials into the complex turbine-blade shapes desired. Good results have been achieved, but further study of the fundamentals of sintering continues.

According to research engineers, the ceramals give promise of even longer life than high-temperature-alloy blades at current operating temperatures. The potential superiority of ceramals over alloys would be even more pronounced if gas temperatures were increased. Before the possible advantages of ceramal blades can be fully exploited, however, further research is required on problems associated with their design, fabrication, and use.

### INSTRUMENT RESEARCH

Another problem of great concern is that of developing new adequate instrumentation.

In the application of rocket engines, for example, one serious problem is unsteady combustion. This instability may bring about rapid burnout of the engine; fuel lines may be broken. In all cases of instability there is a great loss in efficiency. In determining the cause of this instability, it is necessary to measure the rate of flow of the liquid propellants while the engine is under test.

Since available flowmeters did not enable sufficient accuracy of measurement, it became necessary to develop a new instrument which utilizes electromagnetic principles. The new flowmeter responds rapidly to variations of flow rate and has the advantage of not requiring insertions of moving parts in the flow passage. At present, with this device flow of such liquids as water, acids, alcohol, and acetone can be measured. With further development it is believed that flow rates of hydrocarbon fuels can also be measured.

The conventional method of recording pressures from as many as 300 pickup points on an operating turbojet engine has been to connect the pressure probes to a manometer board, of which photographs were taken at frequent intervals. Then it was necessary for a computing staff to read the films with magnifying glasses, record the data, and perform necessary calculations to reduce it to useful form. This process is long and tedious; it is also costly.

The answer has been development of automatic equipment which records both pressures and temperatures on tape and then transmits this information to punch cards. Further work to improve existing equipment continues, but already it is possible to compute from a turbojet-engine test such information as air flow in the engine, thrust, specific fuel consumption, and compressor efficiency, and to accomplish this task within 15 min from the end of the run.

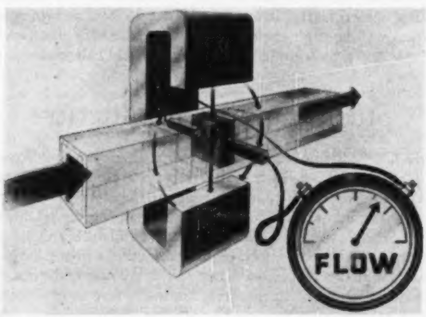


FIG. 4 ELECTROMAGNETIC METER GIVES ACCURATE FLOW RATE

### FUELS AND COMBUSTION

In order to increase the flight speed, altitude ceiling, and economy of operation of jet aircraft, an intensive research program was begun at Lewis to improve combustor performance. The program included both fundamental and applied research on the turbojet, ramjet, and rocket engines.

A major part of the long-range research program was a study of the basic combustion processes of combustible-mixture preparation, ignition, and flame propagation. These processes, which, in jet engines, occur in sequence in a total time of less than 0.01 sec, had to be developed to meet the demands for increased flight speed and higher altitude ceilings.

Studies of the mechanism of spray atomization, high-speed motion-picture observation of the mixing of fuel and air in the combustor, and research on the effect of fuel properties on combustor performance enabled the designer to obtain higher power outputs from smaller combustors along with greater economy due to more efficient utilization of the fuel.

These improved engines operating under the more severe conditions of high altitudes and low temperature created the need for better ignition systems. The combustor could operate under conditions at which ignition could not be accomplished if the flame should blow out during maneuvers. Fundamental research on the proper ratios of the fuel and air required in the vicinity of the igniter, as well as the amount of energy necessary to initiate flame in such mixtures, enabled the designer to raise the ignition ceiling to correspond to the operations ceiling.

At the same time that the high-speed combustion process of the ramjet and rocket were being developed, new fuels capable of releasing large quantities of energy per pound and per cubic foot of fuel were found as well as fuel capable of burning at two to three times the velocity of conventional fuels.

### AFTERBURNER DEVELOPMENT

Fundamental research at the Lewis Laboratory on the use of afterburners began more than 5 years ago and progress has been made to the point where it can now be said this "reheat" device enables the pilot to more than double the useful thrust of his engine at supersonic speeds with only a slight increase in weight and size of the engine.

Basically, the afterburner is a ramjet engine installed in the tail pipe of the turbojet engine. It is an auxiliary power plant characterized by the simplicity of its concept and application. Fuel burned in the exhaust pipe of the turbojet engine increases the temperature of the gases flowing through the engine, and results in an increase in jet velocity, which produces the greater engine thrust output desired.

Operation of afterburners is accompanied by several problems, including combustion efficiency, altitude operating limits, ignition, and combustion stability. Research on all these problems continues, utilizing all the major altitudes and sea-level facilities of the Lewis Laboratory.

With great emphasis presently focused on airplanes capable of flight at supersonic speeds, new problems are introduced in the design of afterburners. There is urgent need for maximum thrust augmentation resulting in extremely high gas temperatures—1500 F above the melting point of the best high-temperature alloys now in use in tail-pipe construction. Obviously, some means of cooling the burner shell must be found which will not penalize airplane performance unduly. Another major problem imposed by supersonic flight is the increased velocities through the afterburner and the consequent difficulty of maintaining combustion within the burners.

CONCLUSION

The combined research on fundamental processes, engine components, and full-scale engines has more than doubled the flight speed of jet aircraft and increased the altitude ceiling more than fourfold in recent years, according to Lewis research engineers. Current research promises even greater future gains, they disclosed. Close work with engine designers and manufacturers has made it possible to contribute greatly to the technical excellence of our country's aircraft.

# Machine-Tool Production

DURING 1951 a major mobilization production problem continued to be machine tools, according to the DPA-NPA Office of Public Information.

Output increased steadily during the year but the backlog of orders increased even more. Several important actions were taken to increase the rate of output. These include the pricing order issued by the Office of Price Stabilization, pool orders, increased allotments of controlled materials, and the establishment of a policy by the National Production Authority, U. S. Department of Commerce, that machine-tool builders would have first call upon the output of their own industry for expansion purposes.

One problem which has continued to vex the machine-tool industry is the lack of definite information about the future machine-tool needs of the mobilization program. The armed services buy very few machine tools themselves. The problem as to what machine tool to use to produce a certain part of a jet engine is usually decided by the contractor building the jet engine. It is not unusual for two or three different contractors building the same item each to use a different production method and a different machine tool. This has made most difficult the problem of forecasting future machine-tool needs with any accuracy. However, the Munitions Board is now undertaking this task and expects in the near future to be able to compile a list of anticipated machine-tool needs.

Because a given piece of equipment can be built with a variety of production methods, utilizing machine tools of varying kinds and types, NPA has requested all defense contractors to screen their machine-tool requirements closely. If a simple tool can do the job efficiently, the manufacturers have been requested to refrain from procuring a more complex tool, particularly if the more complex tool is in short supply.

As industry continues to expand its production during the year, manpower problems have increased, and recruiting and training efforts have had to be stepped up. Greater pirating of workers by other defense plants was noted. Because of the general slowdown during the July vacation period, output for this one month dropped sharply but rebounded immediately. In specific details, the machine-tool program shapes up about as follows:

1 There continues to be a critical shortage of steel plate and certain special types of steel. Too often machines have had to be taken off production lines uncompleted for lack of components and certain special steel items needed for completion.

2 The price problem has been relieved by revision of Ceiling Price Regulation 30, which now permits machine-tool builders to pass along added costs caused by abnormal mobilization demands.

3 Manpower remains one of the greatest problems faced by machine-tool builders. Highly skilled mechanics are needed in this industry. As production is increased, manpower shortages will become more acute.

4 Industry now places the backlog of orders at $1,371,370,000, or more than two years' production at the present annual "going rate" of $650,000,000. A study of the order boards of the machine-tool builders shows that about 70 per cent of their backlog of orders are for direction mobilization contractors. Moreover, NPA believes that most of the balance is either defense-supporting or essential civilian business.

5 During normal times machine-tool builders are prepared to finance their operations. However, stepped-up production places an additional financial burden which many builders are unable to meet. To help them, "V" loans—bank loans guaranteed in whole or in part by the government—have been again made available. In addition, those builders who accept pool orders from the government may obtain cash advances up to 30 per cent of the value of the contract.

6 Pool-order contracts are being given machine-tool builders in increasing numbers by the government. Under present arrangements, a pool order is a commitment on the part of the government to buy certain machine tools from a builder. The builder is expected to exert every effort to sell the tools covered by the government order to a defense contractor before the government is asked actually to take delivery and pay for the tools covered by the pool order.

In any general consideration of the machine-tool industry and its relationship to the mobilization program, a number of key facts should be kept in mind.

First, the industry is smaller, in terms of the number of active firms or the total number of workers employed, than it was when the U. S. entered World War II. At that time the industry had two years of forced-draft operation behind it, with orders from all of the European countries who were opposing the Nazis. Then, when the war finally ended, about one fifth of the machine-tool companies discontinued their business in this field and either dropped out of the industrial scene altogether or shifted to other lines of production.

Second, the companies now in the business have this "boom and bust" experience still vividly in mind. They know that the war-inflated expansion of the industry during World War II caused serious trouble in the reconversion period. Management is less eager this time to rush headlong into a plant and facilities expansion program, because of past experience. It is the job of the government to encourage expansion for the mobilization effort; but the industry has asked that safeguards be made available against abrupt contract termination and depressed markets due to government "surplus property" disposals.

In the considered opinion of those in the industry, and in government, the potential increase in new mobilization orders will be greater than the increase in machine-tool shipments in the months ahead; hence the problem, on a relative basis, is likely to get worse before it gets better. A climax will probably be reached sometime late in 1952 or early in 1953, after which production will be high enough to work off the backlog of orders and the critical nature of the problem should subside.

# Steel-Castings Production

PRODUCTION of steel castings to meet expanding requirements of the defense mobilization program rapidly is nearing record proportions, it was reported recently by F. Kermit Donaldson, executive vice-president, during the annual meeting of the Steel Founders' Society of America in Hot Springs, Va.

Despite manpower shortages and difficulties in securing adequate supplies of necessary scrap and other raw materials, Mr. Donaldson said, the steel-castings industry now is producing at a rate rapidly approaching the all-time high of 1944, during World War II, when the industry shipped 2,445,421 tons. Cur-

rently, he disclosed, the country's 250 steel foundries are operating at a level more than 150 per cent above 1950 and are producing at a rate in excess of 2,200,000 tons yearly, according to official Bureau of Census figures. This compares to shipments totaling 1,461,667 tons in 1950.

Since steel castings are classified as a controlled material under the government's Controlled Materials Plan, Mr. Donaldson explained, practically all of the industry's production is being diverted to fulfillment of direct military and closely related defense-supporting requirements. Basic steel-plant expansion is accounting for a substantial volume of castings orders, and the railroad freight-car and other rail-equipment building programs similarly are requiring heavy steel-castings tonnage.

Shortages of alloying elements, among other vital materials, however, continue to impose serious obstacles for the industry in meeting its defense-production responsibilities, he emphasized. Production of cast armor for tanks, for example, requires substantial quantities of alloys in order to meet the rigid military specifications; and the highest grades of steel scrap, presently in seriously short supply, are essential for the proper manufacture of cast armor. Meantime, Mr. Donaldson said, great ingenuity is being applied by steel-foundry managements, metallurgists, and operating executives in adapting the available materials and alloys.

As a corollary, bottlenecks exist in availability of heat-treating facilities, laboratory testing equipment, and certain cleaning-room equipment, he added; but there is every reason to expect that production will be increased even above the present high level as equipment becomes available to eliminate these bottlenecks.

## Quenching Studies

COLUMBIA University has initiated a long-range program of research in the techniques for hardening steel which may make it possible to employ low-alloy steels in various uses at a considerable saving in critical raw materials now being stock-piled in this country.

The program, the first three-year step of which will cost approximately $35,000 and is being financed by a number of industrial concerns, was announced recently, by Dr. John R. Dunning, Mem. ASME, dean of the University's School of Engineering. It will be headed by Dr. Victor Paschkis, Mem. ASME, technical director of the Heat and Mass Flow Analyzer Laboratory in the Department of Mechanical Engineering. The project for studying thermal problems in quenching will make use of the Heat and Mass Flow Analyzer, a complex electric computer developed by Dr. Paschkis to solve heat-flow problems through the analog method. (See "Heat-Flow Analyzer," MECHANICAL ENGINEERING, June, 1948, page 541.)

According to Dr. Paschkis, the purpose of the program is to "determine the boundary conductance in quenching for different shapes, sizes, and surface conditions, when quenching a sample in different quenching media.

Quenching, as any cooling process, is governed by two factors: Heat conduction in the object being cooled and convection from the surface of the object to the quenching medium. While there is still not adequate knowledge of the properties controlling heat conduction in steel, even less is known about the "boundary conductance"—the heat phenomena on the surface which determines the convection cooling.

Dr. Paschkis pointed out that the boundary conductance not only essentially determines the rate of temperature drop at the surface but influences critically rates of temperature change at different points in the body.

From the Columbia study, Dr. Paschkis hopes to derive sufficient information on the thermal aspects of quenching to make possible the use of low-alloy steels. The latter have been abandoned in favor of high-alloy steels requiring less accurate control in quenching.

In view of the physics involved, it is possible to carry out the experiments with silver or nickel balls, Dr. Paschkis pointed out. The properties of silver are better known than those of steel.

The actual experiment will consist of quenching in various media. Measuring of surface temperatures would be practically impossible but by using the Heat and Mass Flow Analyzer, it is possible to limit measurements to the observation of inside temperatures by extremely thin thermocouples.

Time-temperature charts will be developed from the experimental results. Analysis of these charts by the Heat and Mass Flow Analyzer will give the relationship between the temperature inside the sample, which is measured directly, with the surface temperature and boundary conductance. Once this relationship is known, it will be possible to predict accurately in advance the effect of quenching on various metals of different shapes and sizes in different media.

## Endurance Limit Test

A RAPID and accurate method for determining the endurance limit of steels, other metals, and plastics, variously used for moving mechanical parts such as turbine blades, aircraft propellers, drive shafts, and the like, has been devised by Dr. Joseph L. Rosenholtz, head of geology at Rensselaer Polytechnic Institute, Troy, N. Y., and Prof. Dudley T. Smith, his chief associate. This new development has resulted directly from their studies of stresses in rocks and minerals.

The two scientists found that identical samples from a rod of steel or other material, when heated under exact controls to the same temperature, possess rates of linear expansion which vary with the amount of stress to which each test piece has been previously subjected. They have devised an apparatus which measures such linear expansion to an extremely sensitive degree. By plotting these measurements against the varying stresses of the test bars they can accurately determine just where the endurance limit occurs in the particular material.

Called the R/S Dilastrain Method, the test requires only two hours in itself and, if time for preparing the material for testing is included, a complete test may be finished within ten hours. This compares with months, and sometimes as much as a year, required under present methods for accurately determining the endurance limit of an alloy or other piece of material designed for use in moving parts of machines.

The importance of the new testing method may be estimated from the fact that American industry, both the makers of materials and those who fabricate the materials into engines, planes, and machines, is constantly trying to find new materials which will meet new and exacting requirements or will stand up better and more cheaply than the materials already employed. The defense mobilization has, of course, greatly increased this search for new alloys and materials. And every time a new material is developed there is the great necessity for testing it thoroughly and determining just how it will stand up under the planned load of work.

The endurance limit of any particular material is found under present methods of testing by subjecting test bars to varying loads or stresses and vibrating them until they either give way or prove sufficiently enduring. Such testing may take months, since 500,000,000 cycles, or complete vibrations, may be re-

quired as a practical limit for testing some materials for use as dynamic or moving parts in a machine.

The Rosenholtz-Smith apparatus, as it is presently being demonstrated in the Rensselaer laboratory, uses small test pieces which are fashioned from customary test bars, 6 in. long and $^3/_4$ in. thick. The central 2 in. are machined down to a diameter of about 0.2 in. and then the bars, eight in number, are subjected to stresses in a definite range.

This range is determined by finding the yield point or elastic limit of the material. This is done by subjecting a test bar of the material to a pulling test and finding the force necessary to produce a permanent elongation of the bar.

If the yield point of a metal, for example, is 50,000 psi, the eight test bars are stressed from 60,000 psi down to 25,000 psi, at 5000-lb intervals. All eight are then subjected to 100,000 cycles of vibration to put them on an even level of fatigue. An underwater jig is then used to slice off the ends of each bar and leave the central section in the shape of a small spool, with a 2-in-long shaft and a small head on each end.

The prepared specimens are placed in a bank of eight Dilastrain multipliers. Each has a quartz tube 20 in. long which contains a quartz rod. One end of the rod rests against the end of the test specimen and the other extends against a steel lever. During this operation the room temperature is at 68 F (20 C) and each of the multipliers is immersed in an air bath at this temperature. As the temperature of the air bath is gradually raised to 212 F (100 C) the expansion of the test specimen is transmitted by the quartz rod to the steel lever. The movement of the lever is automatically recorded with a total magnification of 3500 times the expansion of the specimen.

In approximately two hours the total linear expansion of each of the eight test specimens has been recorded. When these values are plotted against the stresses previously applied to the specimens, it is found that a sharp dip in the resulting curve appears at the point where the test material reaches its endurance limit.

For some materials the time of running tests may be sharply shorter than the ten hours required for materials which have been subjected to 100,000 cycles of vibration. Some materials may be accurately tested for endurance when samples are given only 10,000 cycles which requires only five minutes.

The accuracy of the R/S Dilastrain Method has so far been determined in tests on samples of duraluminum, magnesium, soft, medium, and hard steels, naval brass, and polystyrene.

The discoverers of the new testing method are now working on an adaptation which will permit the testing of metal alloys for their endurance limits at extremely high temperatures such as those resulting in jet engines.

# Portable Gas Turbine

A PORTABLE hand-started gas-turbine power plant, said to be the world's first, has been developed by Solar Aircraft Company, San Diego, Calif., on an assignment from the United States Navy. It was ordered by the Bureau of Ships to provide a better method of fighting shipboard fires, but its many possibilities as a compact source of power have already been recognized for other military and civilian uses.

The contract under which the gas turbine, identified as the Solar Model T-45 Portable-Gas-Turbine-Driven Pump, was produced had as a basic requirement that the prime mover be designed to drive a centrifugal water pump of the same rating as the pump used on the Navy's original Type P-500 portable water-pump set. This rating, with sea water, is as follows: Flow, 500 gpm; discharge pressure, 100 psig; suction lift, 16 ft.

### BASIC ARRANGEMENT

A single-stage centrifugal compressor was chosen because of the limitations on compressor pressure ratio imposed by the hand-starting requirement. The influence of size effects, including those of Reynolds number and leakage, and the necessity for holding weight to a minimum, also influenced this choice. Similar factors, as well as the need for simplicity and low manufacturing costs, dictated the use of a radial inflow turbine.

At rated speed of 40,300 rpm, the peripheral speeds of the 6.97-in. compressor rotor and 7.42-in. turbine rotor are 1220 and 1300 fps, respectively.

The arrangement of components is illustrated in Fig. 5. The envelope dimensions of the set are: Length, $26^7/_8$ in.; height, $23^1/_8$ in.; width, $23^7/_8$ in. The dry weight, less fuel and tanks, is 165 lb; fuel for one hour's sustained operation, with tanks, weighs 112 lb additional.

### COMPRESSOR

The centrifugal-type compressor rotor is machined from 25S-T aluminum-alloy forging. Blade leading edges are shaped to serve as an inducer. Both the turbine and compressor rotors are mounted back to back, with a seal plate between, on a common shaft which extends through the center of the compressor scroll and air-inlet casing, Fig. 6. A nine-blade, stainless-steel compressor diffuser is bolted to the scroll. Compressor air is discharged through a bellows-type expansion joint to the combustor inlet. A butterfly valve in the scroll outlet provides a means of creating a low velocity area in the combustor during starting to facilitate ignition.

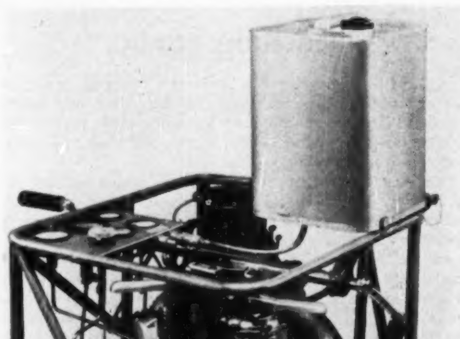

FIG. 5 ARRANGEMENT OF COMPONENTS OF THE SOLAR MODEL T-45 PORTABLE-GAS-TURBINE-DRIVEN PUMP

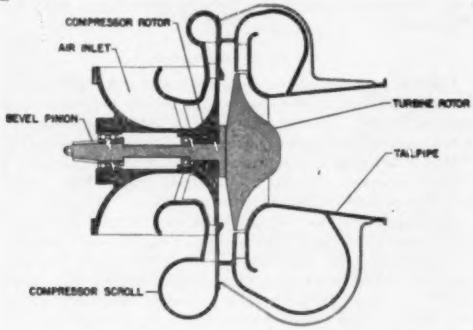


FIG. 6 SECTION DIAGRAM OF PORTABLE GAS TURBINE

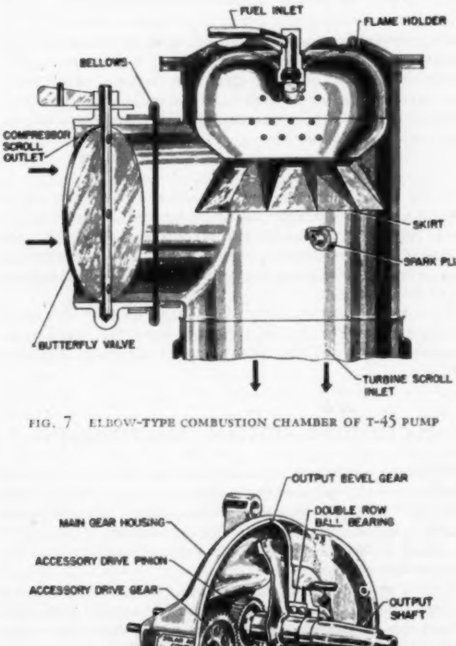


FIG. 7 ELBOW-TYPE COMBUSTION CHAMBER OF T-45 PUMP

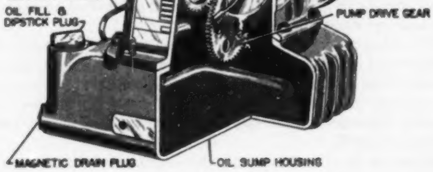


FIG. 8 CUTAWAY VIEW OF MAIN REDUCTION GEAR AND ACCESSORY DRIVE

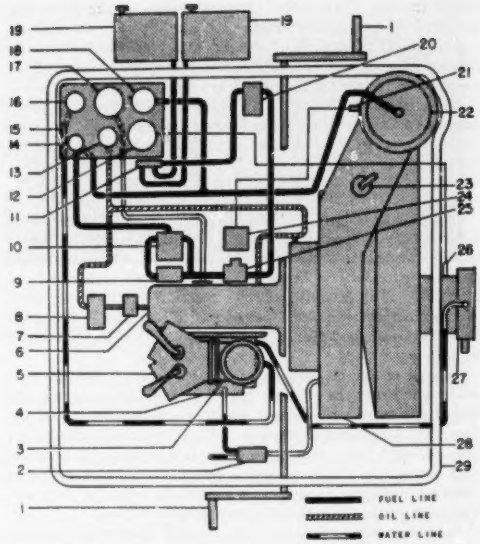


FIG. 9 FUEL SYSTEM ARRANGEMENT OF GAS TURBINE

(1, Starter assembly; 2, primer ejector; 3, primer elbow; 4, pump; 5, Y-valve; 6, gearbox; 7, oil pump; 8, oil filter; 9, fuel pump; 10, governor; 11, fuel manifold; 12, exhaust temperature indicator; 13, oil pressure indicator; 14, throttle valve; 15, control panel; 16, pump discharge pressure indicator; 17, tachometer indicator; 18, fuel pressure indicator; 19, fuel tanks; 20, fuel filter; 21, spark plug; 22, burner assembly; 23, butterfly valve; 24, magneto; 25, overspeed valve; 26, thermocouple; 27, exhaust cooler; 28, turbine; 29, frame)

### COMBUSTOR

Between the compressor scroll outlet and the turbine scroll inlet is a modified elbow-type combustion chamber, formed from Type 321 stainless steel in order to conserve critical materials. As shown in Fig. 7, it differs from the normal gas-turbine combustor in that there is no liner, but only a short, flared, dome-shaped flameholder set in the turbine scroll opening. An 8.3-gph, 80-deg-spray-angle Monarch nozzle admits fuel to the air stream through the flared skirt of the dome. An aircraft spark plug, set just below the skirt, initiates combustion, which is held inside the dome or flameholder.

### TURBINE

The blades of the radial inflow turbine rotor are shaped to form an exducer in the same manner that the compressor blades are shaped to form an inducer. The rotor is encircled by the turbine scroll and nozzle, and a short tail pipe is centered behind the rotor hub. No exhaust diffuser is used. Hot gases pass from the combustor into the turbine scroll and are directed angularly inward by the turbine nozzle blade contour. Thence they whirl farther inward through the rotor and turn to exhaust axially through the tail pipe. A Hastelloy B forging was chosen for the turbine rotor.

Antifriction ball bearings are used exclusively in the power plant, and since the pump impeller is mounted on the speed-reducer output shaft, there are no bearings in the pump.

Speed reduction between the 40,300-rpm power unit and the 4428-rpm water pump is accomplished by a 9.1 to 1 spiral bevel gear and pinion combination as shown in Fig. 8.

Fuel for one hour's sustained operation at full load is con-

tained in two 7-gal tanks. During operation the tanks are mounted on the tubular frame of the unit above the turbine tail pipe. Each tank is connected to a fuel manifold on the control panel by a short hose and self-sealing coupling. Fuel system arrangement is illustrated in Figs. 5 and 9.

A gear-type oil pump with integral pressure-relief valve draws lubricating oil from the reservoir, pressurizes it to a constant 20 psi, and delivers it at 0.75 gpm to the turbine and reduction-gear bearings.

###### STARTING

In so far as is known, the T-45 is the first gas turbine ever built which is started by hand. Careful thought and effort were expended on design features which would minimize the exertion necessary to bring the turbine up to speed by hand cranking. The feasibility of the method was in doubt until the mechanism was actually constructed and tried. It proved to be practical, however, and the main contributing factors are as follows:

First, a moderate pressure ratio was selected, because normally the lower the pressure ratio of a gas-turbine engine, the lower the speed at which it becomes self-sustaining and the less effort is required to crank it. Another factor in choosing a pressure ratio lower than those possible with this type of wheel and reasonable efficiencies was a design compromise forced by limiting turbine tip speed to an acceptable value for the material strength at the turbine operating temperature.

Second, mechanical losses were avoided by eliminating bearings where possible, and using antifriction type where bearings were essential.

It was assumed during initial design that hand starting would be significantly aided by the use of a manual butterfly valve in the compressor discharge. This valve would be closed, taking pumping load off the compressor, during acceleration up to ignition speed, and then opened for the balance of the cycle. In practice, however, this effect was found to be of little help, although the valve was retained to insure positive ignition at all times.

The chain and sprocket arrangement between hand cranks and pump shaft, with the gear-and-pinion pump-to-turbine connection, provides an 81 to 1 speed increase in the starting train, and leads to a practicable torque on the cranks during accelerations. When turbine speed exceeds crank input speed, a Formsprag overrunning clutch on the pump shaft disengages the starting device.

The step-by-step sequence of starting operations is as follows:

1 With the butterfly valve closed, cranking is started and continued until pump speed reaches 500 rpm. Then the throttle is opened.

2 At this speed the magneto is delivering ignition current to the spark plug, and combustion commences. The butterfly valve is opened immediately.

3 Cranking is continued, with throttle adjustments made manually to keep turbine exhaust temperature within the specified starting range, until 1200-rpm pump speed is reached.

4 From this point on the engine is self-sustaining, and with continued throttle adjustments (step 3) it will accelerate up to governed speed without cranking.

###### EXHAUST COOLING

Because exhaust gases from the turbine cannot always be directed away from working areas and surrounding structure when operating the fire pump, the turbine tail pipe is equipped with a cooling device consisting of a hollow-cone-type nonclogging spray nozzle in the tail pipe, which introduces water from the pump discharge into the exhaust stream at about 3 gpm. Exhaust temperature is held down to 350 to 400 F by this method.

###### OPERATING EXPERIENCE

Final shop testing of the T-45 was begun in January, 1950. Initial no-load starts were made with battery ignition, using gasoline for fuel. After a proper sequence of starting operations was established, magneto ignition and Diesel fuel were used. The only difference in operation noted from this change was a slightly slower acceleration below 20,000 rpm. Above 20,000 rpm there was no appreciable difference.

After several no-load full-speed runs were completed to check temperatures and proper functioning of controls and accessories, full-load tests were begun. The power plant was disassembled 15 times for inspection, repairs, and minor changes. In all, 278 starts were logged with a total operating time of 38.3 hr, 11.8 hr of which were at loads ranging from 7 to 125 per cent of rated load.

Data obtained showed that an 83-F increase in turbine-inlet temperature results in an 18 per cent increase in power output and an 11 per cent decrease in specific fuel consumption. From this it can be foreseen that future development toward higher average turbine-inlet temperature will give greater power and efficiency without change in over-all size and weight. The present design limit of 1300 F maximum turbine-inlet temperature, based on the use of noncritical materials, could be raised substantially by employing critical high-temperature alloys, or by turbine wheel cooling.

###### LIFE

At the present time there are not sufficient data from which definite life characteristics can be determined. However, the design life goal of at least 500 hr total operating time with 50 hr minimum time between replacement of the combustion chamber liner or bearings appears to be reasonable and should be achieved without difficulty.

The foregoing material is based on a paper by A. D. Zakarian, project engineer for the Solar Aircraft Company, and Roy R. Peterson, Bureau of Ships, Department of the Navy, Washington, D. C.

# Remote-Control Microscope

DEADLY radioactive materials, hidden behind a thick concrete wall, can now be studied safely and photographed under a microscope by atomic scientists, using a new instrument jointly announced by American Optical Company's Instrument Division, at Buffalo, N.Y., who built the device, and the General Electric Company.

First of its kind, the instrument is being installed in the Knolls Atomic Power Laboratory, operated at Schenectady by General Electric for the Atomic Energy Commission. According to Dr. Kenneth H. Kingdon, technical manager of the laboratory's technical department, it is expected to make possible investigations that have never before been accomplished on the effects of radiation damage to materials.

The instrument is a special microscope for examining the structure of metals, combined with camera, periscopes, and an illuminating system, in such an arrangement that light can get in and out through the thick walls of the test chamber, but nuclear radiations from the radioactive specimens are completely blocked.

Operated by remote control, the instrument permits atomic researchers to work in complete safety. Some sort of remotely controlled "mechanical hands," similar to those developed by KAPL engineers and first announced in 1948, could be used to

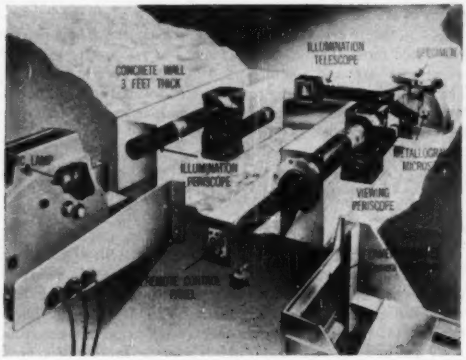


FIG. 10 SCHEMATIC DIAGRAM SHOWS THE OPERATION OF THE REMOTELY CONTROLLED MICROSCOPE

place the specimens in position, and to remove them after examination. (See "Mechanical Manipulator," MECHANICAL ENGINEERING, August, 1948, page 690.)

Light for illumination of the specimen comes from an arc lamp outside the thick-walled test chamber, and goes into the chamber through a lens system placed in a tubular hole through the wall. The light is reflected from the specimen, and comes out again through another series of lenses, to form the magnified image.

Both lens systems are offset by means of mirrors which change the light path from horizontal to vertical, and then back to horizontal again. Radiations from inside the test cell are not reflected, and cannot get around the offset. If the tubes were straight, however, they might be able to emerge through the opening for the lenses.

In using the microscope, which extends into the test chamber, the specimen is put into place on the microscope stage. Looking through a single eyepiece, the operator employs the remote controls to get the specimen adjusted and properly focused. Then the visual eyepiece is exchanged for a photographic one, and the camera is swung into position to make the photograph.

At the lowest power, the instrument shows the specimen in its actual size, without any magnification, whereas 1000-diam magnification may be obtained with the highest power. These different powers are achieved by the use of several objective lenses for the microscope, which are mounted on a revolving turret and can be swung into place, again by remote control, as desired. The objectives are so adjusted that it is not necessary to refocus when changing from one power to another.

Polarized light, consisting of vibrations in a single plane, as opposed to ordinary light in which the vibrations are in many different directions, is invaluable in the study of metals, and may also be used. This is made possible by a light-polarizing slide in the path of light from the illuminator. By remote control the slide may be put in or out of position as desired.

FIG. 11 AUTOMATIC DEVICE FOR MACHINING BY REMOTE CONTROL

[Heart of robot machinist is a punching mechanism (*left*) which translates blueprint co-ordinates into tape perforations. Sensor (*right*), converts perforations into electric signals.]

## Robot Machinist

THE day of the automatic factory has been brought closer by a robot machinist developed by Daco Machine Company, Brooklyn, N. Y. This new device will operate a machine tool from an engineer's office or other distant point. According to the company, remote-control possibilities are practically unlimited; it would be just as easy to have a robot located in Detroit, for example, operate, via teletype, machine tools in Los Angeles or New Haven.

Ideal for mass-production plants having long repetitive runs of metal-cutting operations, the robot has wide application in all types of defense production, Daco engineers said. Complicated machining operations would no longer depend on the skill of the operator; the "skill" lies in the electric robot.

The parts that make up the robot device are a paper-tape perforator, a sensor that translates the tape message into electric impulses that actuate selsyn motors which, like the operator's hands, tell the machine what to do. Perforations in the tape represent essential dimensions shown on the blueprint for the part to be machined. When the tape travels through the sensor, electric contacts are made and broken through the holes to complete and break electric circuits. This produces varying voltages in the sensor that accurately control movement of the cutting tool and workpiece in the machine.

It is reported that machining accuracy is in no way influenced by the robot. Deviations in the dimensions of the machined part, if any, are the fault of the tool.

About the only manpower needed around the machine tool is for loading and unloading the work. As is usually done, dimensions will be checked periodically to see that parts are within tolerance limits and to determine when worn tools need to be replaced.

The robot is flexible too because it is not wedded to the machine tool. Once a production run is completed on a given machine, the device can be attached to another to do a completely different job.

Brains of the Daco-built device are in the tape. It can be punched out by a draftsman who makes computations from a blueprint. In effect, he places the part drawing over a gridlike graph paper. Holes in the tape represent points and surfaces on the part. A plant operating such robots would probably keep a file of master tapes representing various arcs, flat surfaces, and fillets. To set up a tape for machining a part, a series of master tapes of the right combination could be fastened together.

## Corrosion Prevention

AN economical method of preventing rust and corrosion of metal parts, in the presence of air and moisture, is provided by "VPI" crystals, a slightly volatile amine nitrite now being made available to industry by the Shell Oil Company, New York, N. Y. This volatile corrosion inhibitor is now being used in protecting metal parts, assemblies, instruments, and

finished products during shipment, storage, and through various processing steps, according to the company.

Being slightly volatile at atmospheric temperatures, VPI gives off vapors which are carried by convection and diffusion to all surfaces of the metal, where they condense to provide a thin protective layer.

VPI, a powderlike substance, can be applied by placing it in a package enclosing the parts to be protected (as in an envelope containing ball-bearing races); by blowing it into an area to be protected (as in the aircraft engines, where it is blown into spark-plug holes, cylinder bores, and other ports); by putting it into a water or alcohol solution (as in the protection of metal parts during and between processing steps such as grinding) and covering the metal parts in tote boxes. An unusual characteristic of VPI is that it will arrest corrosion at any advanced stage.

When using VPI, ventilation of the enclosure in which parts are stored should be kept to a minimum to insure the maximum protection period, and the parts should be no further than 2 ft from the VPI source. Metal parts protected by VPI are ready for instant use since there is no grease or oil to remove. Relatively small quantities of VPI, established by practice, are required to give adequate protection. It is claimed that one gram of VPI will protect a cubic foot of metal parts, or surface, for periods up to a year. Solutions of from 2 to 4 per cent are effective in protecting processed metal parts. Two types of VPI are available: VPI 220, which has greater vapor pressure but less stability at higher temperatures than VPI 260, which is more widely used by industry.

Although VPI is just now being offered to industry on a broad basis it has been proved effective in preventing costly corrosion, under difficult conditions, in aircraft engines, precision instruments, tools and dies, Diesel engines and parts, sandblasted parts, continuous steel strip, steel rods, steel forgings, ball and roller bearings, water pumps, large fabricated sheet-metal components, stamped parts which are to be plated, and tank trailers.

## Corrosion Testing

FURTHER facilities for the study of sea-water corrosion are being added to the Harbor Island Station of the Kure Beach project, near Wilmington, N. C., it was announced by F. L. LaQue, in charge of International Nickel Company's corrosion engineering section, under whose supervision the project is operated.

Included in the new facilities will be a full-sized salt-water evaporator and distillation unit to study the effects of water treatment and design on corrosion and scaling of such units—especially as used on board ship. The equipment will include a boiler plant with a capacity of 4000 lb of steam per hr.

The new unit will be housed in the present laboratory building at Harbor Island, and to replace the space thus used, a new two-story concrete structure will be erected on the site. The first floor will be used by machine and carpenter shops and for the new boiler. The second floor will provide for a meeting room to accommodate up to 75 people as well as a marine museum where specimens of wood, metals, and other materials removed from test will be displayed. Additional facilities will be provided for laboratory studies of marine organisms and other biological studies. An enlarged photographic darkroom also will be provided.

Concurrent with the erection of the new building at Harbor Island, the facilities for exposure of specimens to sea spray near the ocean at Kure Beach are being extended by a new test lot located about 80 ft from the ocean. This will increase the capacity of existing sea-spray facilities approximately three times.

During the 16 years of its existence, the Harbor Island project has tested more than 20,000 specimens in sea water, 25,000 in sea atmosphere, and a somewhat smaller number in sea spray. The atmospheric and spray tests are still located at Kure Beach. Specimens studied include metals, wood, rope, and even protective coatings such as paint.

## Diesel Aircraft Engine

PUBLIC test flights of a four-cylinder, four-cycle, opposed, air-cooled, aircraft Diesel engine mounted in a model 18 Taylorcraft airplane, were made recently by Diesel Power, Inc., at Conway, Pa. Built to Army specifications, the plane made the test flights to prove that this extremely lightweight Diesel engine (245 lb) would fly on a fuel consumption not exceeding 3 gal per hr as compared with the fuel consumption of as much as 9 gal per hr for a gasoline engine of comparable horsepower.

In designing and building the first engine, Diesel Power took a rebuilt, gasoline, air-cooled aircraft engine and replaced the old cylinder heads with Diesel-power-designed combustion chamber and fuel injection, discarding the original magnetos, ignition wiring, spark plugs, carburetor, and fuel-supply pump. The compression ratio of these original gasoline engines was less than 7 to 1. In applying the Diesel development to these engines, the compression ratio was increased to as much as 14 to 1 and in some instances 16 to 1 with no damaging consequences.

The new Diesel engine has a sea-level horsepower rating of 100 at 2400 rpm and 125 hp at 2600 rpm. The bore of the engine is $4^7/_8$ in., and the stroke $3^7/_8$ in. Displacement is 290 cu in.

Numerous advantages of the Diesel over the gasoline engine for flying were cited by the company. It is indicated that the new-type engine will be able to fly three times as far on common Diesel fuel, gas oil, or even kerosene, as on gasoline. This is highly important to light aircraft users with their limited fuel capacity, and is equally important to the big transport and commercial and military planes. Also, the fuel for the Diesel engine costs less than half that of gasoline, but it is the longer flying mileage that really counts. There is the great advantage also of not having to warm up the engine before taking off, as is necessary with the gas engine. This new development is just as applicable to the highest-powered aircraft engines as it is in the small aircraft engine, according to the company.

In flying, the company reports, the Diesel engine has the advantage over gasoline engines of gaining power (propeller rpm) as the plane climbs, instead of losing as is the case with the gasoline engine. The gasoline engine burns 15 parts of air to one part of gasoline, whereas the Diesel engine uses 30 parts of air to one part of Diesel fuel. It is believed this new Diesel engine will add as much as 40 per cent to the ceiling of the gasoline engine. Tests will shortly be made to prove this point. These advantages are made possible because of the fact that on each firing stroke of the cylinder an accurately measured amount of fuel is injected into the combustion chambers under 1500 psi pressure. There is no spinning of the engine, as in the instance of the gasoline engine, waiting for the suction stroke of the conventional four-cycle engine to suck air through the carburetor and eventually provide an ignitable air-fuel mixture for combustion. In this new Diesel the cylinder's combustion chamber receives as much fuel and air at the end of the first compression stroke as it will on the 1000th. Other Diesel advantages include the elimination of the electric ignition system and its interference with radio, and the freezing of carburetors.

# ASME TECHNICAL DIGEST

*Substance in Brief of Papers Presented at ASME Meetings*

## *Production Engineering*

**Thermophysical Aspects of Metal Cutting,** by B. T. Chao, K. J. Trigger, Mem. ASME, University of Illinois, Urbana, Ill., and L. B. Zylstra, Jun. ASME, University of Washington, Seattle, Wash. 1951 ASME Annual Meeting paper No. **51—A-41** (in type; to be published in Trans. ASME).

SOME basic issues in the theory of metal cutting are analyzed in the earlier part of this paper. Several controversial subjects are clarified by the experimental results presented. The remainder of the paper describes a further attempt to ascertain the effect of cutting speed and feed on the mechanism of chip formation in high-speed machining operations. A differential equation of the temperature field in the chip as well as that in the workpiece has been set up, and the nature of the solution studied. It has been found that the temperature distribution both in the work material and in the deformed chip in the immediate vicinity of the tool-chip interface depends upon a dimensionless number which is expressible as the ratio of the product of the cutting speed and feed to the thermal diffusivity of the metal cut. This ratio is called the thermal number, and its significance in metal cutting is illustrated and the limitations discussed.

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**A Comparison of Parameters for the Machining of Gray Cast Iron,** by L. V. Colwell, Mem. ASME, University of Michigan, Ann Arbor, Mich., H. J. Holmes, Ford Motor Company, Ypsilanti, Mich., and F. B. Rote, Albion Malleable Iron Company, Albion, Mich. 1951 ASME Annual Meeting paper No. **51—A-47** (in type; to be published in Trans. ASME).

THIS investigation was designed to compare several types of data as parameters for predicting cutting speeds for gray iron. A series of eleven irons, representing ranges of alloys, ferrite, graphite, and mechanical properties were used in the study. Cutting forces, power, and energy were determined from drilling and milling tests, and cutting speed - tool life lines were determined for each of the irons. Finally, correlations were attempted between the cutting speed (V20) for a 20-min tool life, and all other available types of information.

The net result of this approach was a comparison of the relative reliability of the different types of data. This comparison showed that combined carbon, microhardness, and the nucleation or graphitizing tendency hold the greatest promise of developing into reliable parameters, while Brinell hardness, tensile strength, drilling forces, and milling power show little promise of providing useful information. This study was preliminary in nature and was intended only as a screening process for narrowing down the field for future investigations. Consequently, the correlations between cutting speed and combined carbon, microhardness, and nucleation tendency are undeveloped, and applications should not be attempted without further investigation.

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**Tool Forces and Tool-Chip Adhesion in the Machining of Nodular Cast Iron,** by K. J. Trigger, Mem. ASME, B. T. Chao, University of Illinois, Urbana, Ill., and L. B. Zylstra, Jun. ASME, University of Washington, Seattle, Wash. 1951 ASME Annual Meeting paper No. **51—A-39** (in type; to be published in Trans. ASME).

THIS paper presents the results of an investigation on the machining characteristics of nodular cast iron in both the as-cast and the annealed conditions. Tool forces, cutting temperatures, and tool-chip contact areas are compared for different grades of cemented-carbide tools. An adhesion phenomenon observed with this material provides evidence in support of the oxide-film theory and provides an explanation for some of the differences in wearing qualities of cemented-carbide tools.

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**Measuring the Cooling Properties of Cutting Fluids,** by G. M. Hain, The Cincinnati Milling Machine Company, Cincinnati, Ohio. 1951 ASME Annual Meeting paper No. **51—A-40** (in type; to be published in Trans. ASME).

THE ability of a cutting fluid to reduce the temperature at the chip-tool interface in the machining of metals is of utmost importance to long tool life. This ability depends, in part, on the heat-transfer properties of the fluid. This

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paper describes a simple technique for evaluating the heat-transfer properties of fluids. An alternating current of about 50 amp heats the walls of a length of stainless-steel hypodermic tubing while fluid is forced through it at a constant rate. Thermocouples brazed at intervals to the outside of the tube wall measure the wall temperature from which heat-transfer data are derived.

relation to similar data obtained on simple tension specimens. Failures obtained under test conditions are compared with similar failures suffered by tubes in actual service.

# *Properties of Metals*

**Effect of Temperature Variation on the Long-Time Rupture Strength of Steels,** by Ernest L. Robinson, Fellow ASME, General Electric Company, Schenectady, N. Y. 1951 ASME Annual Meeting paper No. **51—A-33** (in type; to be published in Trans. ASME).

THIS paper presents a method of computing the factor of safety of a structural member with reference to a stated life, when operating under stress at high temperature when the temperature varies or when the stress varies moderately according to some definite pattern. The formulas presented herein are based on the supposition that the expenditure of each particular fraction of the life span at elevated temperature is independent of and without influence upon the expenditure of all other fractions of the life to rupture. The author makes no claim that this assumption is wholly true. The suggested procedure is offered simply to provide a means for making engineering estimates with some greater validity than always to assume that the worst conditions are present all the time. The desirability of taking account of certain additional influences which may differ from one material to another is recognized.

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**Behavior of Superheater Tubing Materials in Contact With Combustion Atmospheres at 1350 F,** by H. A. Blank, A. M. Hall, and J. H. Jackson, Battelle Memorial Institute, Columbus, Ohio. 1951 ASME Annual Meeting paper No. **51—A-42** (in type; to be published in Trans. ASME).

WITH steam temperature of central-station boiler plants advancing to 1050 F in new installations today, and with indications that steam temperatures of 1200 F are not too far in the future, selection of suitable materials for superheater and reheater tubing requires special consideration. Alloys having good service characteristics in the range of 1100 F to 1350 F are required to meet the foregoing steam conditions. While mechanical properties of such alloys are not too serious a problem, the matter of corrosion resistance is a critical one. The ASME Special Research Committee on High-Temperature Steam Generation, recognizing the importance and the complexity of the corrosion problems, undertook sponsorship of a comprehensive program to evaluate commercially available alloys for suitability as superheater and reheater tubing at metal temperatures up to 1350 F. (The program is divided into two broad parts.) One is concerned with the reaction of high-pressure high-temperature steam on such materials. The other deals with corrosion by flue gases and slag-forming ash on the external surface of the tubing, and is divided in turn into two phases. The specific objective of one phase is the evaluation of the alloys with respect to resistance toward corrosion by the combustion products of the various fuels used for boilers, under actual field conditions. The objective of the other phase, carried out in the laboratory, is the investigation of the effect of certain components of a combustion atmosphere on the rate of corrosion of the same alloys. This paper is concerned with the field-test phase of the program which was carried out at Battelle. The laboratory work done at Battelle will be the subject of a future paper.

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**High-Temperature Stress-Rupture Testing of Tubular Specimens,** by L. F. Kooistra, Mem. ASME, R. U. Blaser, and J. T. Tucker, Jr., The Babcock & Wilcox Company, Alliance, Ohio. 1951 ASME Annual Meeting paper No. **51—A-44** (in type; to be published in Trans. ASME).

A LARGE percentage of the high-temperature alloys is used in tubular form but most of the high-temperature strength data for these materials are based on simple tension bar specimens. Testing these materials in the shape and condition in which they are used eliminates many of the discrepancies between test specimen and actual service. A method has been developed in which a tubular specimen under internal steam pressure and at a controlled temperature is tested in stress rupture. This method closely simulates actual service conditions, except for the external flue-gas atmosphere and the temperature gradient through the tube wall existing in heat-transfer service. A suitable environment can, however, be provided when service conditions are known. The test apparatus is described and a number of the test results are discussed in relation to similar data obtained on simple tension specimens. Failures obtained under test conditions are compared with similar failures suffered by tubes in actual service.

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**A Time-Temperature Relationship for Rupture and Creep Stresses,** by F. R. Larson, Watertown Arsenal, Watertown, Mass., and James Miller, General Electric Company, West Lynn, Mass. 1951 ASME Annual Meeting paper No. **51—A-36** (in type; to be published in Trans. ASME).

A RELATION which evaluates the relative effects of time and temperature on the tempering of steels has been developed by previous investigators. In this paper this relation has been adapted to rupture and creep behavior and applied to existing data on several widely different alloys with outstanding results. Methods are described by which short-time tests can be used to determine long-time properties.

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**Rupture and Creep Characteristics of Titanium-Stabilized Stainless Steel at 1100 to 1300 F,** by J. W. Freeman and A. E. White, Fellow ASME, Engineering Research Institute, University of Michigan, Ann Arbor, Mich., and G. F. Comstock, National Lead Company, New York, N. Y. 1951 ASME Annual Meeting paper No, **51—A-46** (in type; to be published in Trans. ASME).

RUPTURE and creep strengths were established at 1100, 1200, and 1300 F for 18-8 + Ti steel heat-treated at 1900 and 2050 F. Several Ti/C ratios were included as a variable. Creep and rupture strengths were higher for the higher-temperature heat-treatment. The lower Ti/C ratio steel had the higher strengths for a given heat-treatment, although this effect was somewhat less than that of temperature of heat-treatment. Limited tests indicated that water-quenching prior to testing slightly improves strength at 1100 F and reduces it at 1300 F. The steels varied in susceptibility to sigma-phase development during testing. The lower Ti/C ratio steels were less susceptible than the higher. In the commercial steels tested, those steels which developed sigma phase had abnormal creep characteristics, with first-stage creep virtually absent and increasing creep rates at short-time periods and low creep rates. This indication of premature third-degree creep was false in that prolonged testing established a true secondary creep rate as predicted by the rupture tests. Use of the minimum creep rates of short duration for establishing the usual creep strengths led to values estimated to be 1000 to 3000 psi high. The creep and

rupture strengths of 18-8 + Ti and 18-8 + Cb steels probably have about the same range in strengths at high temperatures. Under present specifications it is entirely possible to have very low or very high strengths for both steels.

# *Fluid Meters*

**An Investigation of Electromagnetic Flowmeters,** by H. G. Elrod, Jr., Jun. ASME, and R. R. Fouse, Babcock & Wilcox Company, Alliance, Ohio. 1951 ASME Annual Meeting paper No. **51—A-79** (mimeographed; to be published in Trans. ASME).

THE measurement of the flow of molten corrosive metals in small sizes of conduit presents a number of difficulties. Of the devices and methods for accomplishing such a measurement, electromagnetic (EM) flowmeters appear to possess the greatest number of advantages. Accordingly, the work described in this paper was undertaken to acquire further knowledge of the characteristics of these instruments and some experience in their operation.

The theory of EM flowmeters has been generalized to account for the short-circuiting by a conducting tube wall of the electromotive force (emf) generated by the internal flow. The theory has been confirmed, in the case of mercury, by tests with alternating-current and direct-current flowmeters, and with both conducting and nonconducting tube walls.

An EM flowmeter has been developed to conform with the theory, and sufficient information is given in the paper to permit this flowmeter to be reproduced.

On the basis of the experiments performed with mercury, and the physical assumptions required for the theoretical analysis, the following empirical relation may be tentatively employed:

Actual volumetric (mean velocity) = ($1.04 \pm 0.04$) theoretical velocity (Based on Experimental emf) provided (*a*) the fluid wets the tube wall or emf contacts and (*b*) the applied magnetic field is adjusted to a low enough value for the flowmeter emf to vary linearly with the field strength. Distortion of the fluid-velocity profile is thereby minimized.

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**Linear-Resistance Meters for Liquid Flow,** by R. C. Souers and R. C. Binder, Mem. ASME, Purdue University, West Lafayette, Ind. 1951 ASME Annual Meeting paper No. **51—A-57** (in type; to be published in Trans. ASME).

A LINEAR or linear-resistance type of flowmeter can consist of a straight piece of pipe with a porous plug, or a resistance element and a differential gage across the porous plug. In a certain flow range the volume rate of flow through the meter is directly proportional to the pressure drop across the plug. An investigation was made of linear flowmeters with copper-wool and brass-screen disk elements; the fluid was water. The tests cover a range of plug lengths and plug specific weights. A set of dimensionless ratios is proposed for a correlation of all the data for general application.

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**Pulsations in Gas-Compressor Systems,** by E. G. Chilton, Jun. ASME, and L. R. Handley, Jun. ASME, Shell Development Company, Emeryville, Calif. 1951 ASME Annual Meeting paper No. **51—A-90** (mimeographed).

THIS report presents the causes of pulsations, their effects on the piping and the compressor, and the methods by which pulsations can be reduced. By means of an analogy to electrical networks, the interaction between the compressor and the piping can be more easily visualized and the action of the system can be expressed in mathematical form. The resultant equations are not readily solvable but can be simplified and solved for the special cases which have a tank or filter close to the compressor. The results of the computations are compared with experiments on a laboratory compressor and a few large-size installations. They are expressed in the form of graphs which make it possible to select an appropriately sized surge tank or filter for any compressor and any allowable pulse magnitude.

SCHEMATIC DIAGRAM OF π-TYPE FILTER

Some of the recommendations for design of compressor installations brought out in the paper are as follows:

1 In general, a single tank is the simplest and most satisfactory pulse eliminator.

2 Allowable pulse amplitudes should be determined from experience, but an upper limit of 2 per cent seems safe for the average installation.

3 Filter-type dampers will prove efficient only if it is more important to remove pulses from the line than from the compressor.

4 The only filter considered here is the π-type filter since it appears to be as efficient as any.

5 It is essential that any damper, whether a filter or a single tank, be connected as close to the compressor cylinder as possible and that any pipe connecting it with the cylinder be of large diameter and have no sharp corners.

6 Should resonant pulsations occur in any section of the line and should it be undesirable to change the length of that line or introduce a damper, experience indicates that the use of an orifice of one half the pipe diameter placed in the resonant section will result in a material improvement.

7 Double-acting compressors can be treated like single-acting pistons of twice the crankshaft rpm if the assumption can be made that each side of the double-acting piston discharges approximately half the total amount of gas.

# *Applied Mechanics*

**The Bending of Uniformly Loaded Sectorial Plates With Clamped Edges,** by H. D. Conway, Jun. ASME, and M. K. Huang, Cornell University, Ithaca, N. Y. 1951 ASME Annual Meeting paper No. **51—A-24** (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper analyzes the bending of a sectorial plate, clamped on all edges and subjected to uniformly distributed load, by using two different methods of superposition on the elementary solution for a uniformly loaded circular plate with a clamped edge.

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**Linear Bending Theory of Isotropic Sandwich Plates by an Order of Magnitude Analysis,** by George Gerard, Jun. ASME, New York University, New York, N. Y. 1951 ASME Annual Meeting paper No. **51—A-31** (in type; to be published in the *Journal of Applied Mechanics*).

BY use of an order-of-magnitude analysis, the equilibrium and stress-strain relations for the faces and core of a sandwich plate are examined in terms of the thickness of the plate. The analysis results in a set of simplified stress-strain relations for the sandwich plate, in addition to which the basic assumptions of previous sandwich-plate bending theories are obtained as the end result.

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**Bending of a Circular Beam Resting on an Elastic Foundation,** by Enrico Volterra, Mem. ASME, Illinois Institute of Technology, Chicago, Ill. 1951 ASME Annual Meeting paper No. **51—A-18** (in type; to be published in the *Journal of Applied Mechanics*.)

SAINT Venant's equations for a circular beam, bent out of its plane of initial

curvature, are applied to the study of the deflections of beams resting on elastic foundations and loaded by concentrated symmetric forces. The solution of the problem is given in explicit form, and tables for the deflections, angles of twist, bending and twisting moments are presented.

**Bending of a Cylindrically Aeolotropic Circular Plate With Eccentric Load,** by A. M. Sen Gupta, Bengal Engineering College, Sibpur, Howrah, West Bengal, India. 1951 ASME Annual Meeting paper No. **51—A-17** (in type; to be published in the *Journal of Applied Mechanics*).

THE problem of small-deflection theory applicable to plates of cylindrically aeolotropic material has been developed, and expressions for moments and deflections produced have been found by Carrier in some symmetrical cases under uniform lateral loadings and with different boundary conditions. The author has also found the moments and deflection in the case of an unsymmetrical bending of a plate loaded by a distribution of pressure of the form $p = p_0 r \cos \theta$, with clamped edge. The object of the present paper is to investigate the problem of the bending of a cylindrically aeolotropic circular plate of uniform thickness under a concentrated load $P$ applied at a point $A$ at a distance $b$ from the center, the edge being clamped.

**On the Axisymmetric Problem of the Theory of Elasticity for an Infinite Region Containing Two Spherical Cavities,** by E. Sternberg, Jun. ASME, and M. A. Sadowsky, Illinois Institute of Technology, Chicago, Ill. 1951 ASME Annual Meeting paper No. **51—A-10** (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper contains a solution in series form for the stress distribution in an infinite elastic medium which possesses two spherical cavities of the same size. The loading consists of tractions applied to the cavities, as well as of a uniform field of tractions at infinity, and both are assumed to be symmetric with respect to the common axis of symmetry of the cavities and with respect to the plane of geometric symmetry perpendicular to this axis. The loading is otherwise unrestricted. The solution is based upon the Boussinesq stress-function approach and apparently constitutes the first application of spherical dipolar co-ordinates in the theory of elasticity. Numerical evaluations are given for the case in which the surfaces of the cavities are free from tractions and the stress field at infinity is hydrostatic. The results illustrate the interference of two sources of stress concentration in a three-dimensional problem. The approach used here may be extended to cope with the general equilibrium problem for a region bounded by two nonconcentric spheres.

**The Effect of a Rigid Circular Inclusion on the Bending of a Thick Elastic Plate,** by R. A. Hirsch, Brown University, Providence, R. I. 1951 ASME Annual Meeting paper No. **51—A-12** (in type; to be published in the *Journal of Applied Mechanics*).

THE three-dimensional problem of the effect of a rigid circular inclusion on the bending of a thick elastic plate is solved approximately by the method of E. Reissner. Comparison is made for the limiting cases of vanishing inclusion size, (plane strain), and vanishing thickness (Poisson-Kirchhoff plate theory), with the work of J. N. Goodier and M. Goland. Graphs showing the transition from the plane-strain solution to the Poisson-Kirchhoff solution are given. Stress concentrations are calculated and plotted versus the inclusion diameter-plate thickness ratio. The stress concentrations are found to be less than predicted by the classical plate theory when the inclusion diameter approaches the same order of magnitude as the plate thickness.

**Several Approximate Analyses of the Bending of a Rectangular Cantilever Plate by Uniform Normal Pressure,** by W. A. Nash, Jun. ASME, David Taylor Model Basin, Washington, D. C. 1951 ASME Annual Meeting paper No. **51—A-28** (in type; to be published in the *Journal of Applied Mechanics*).

THREE methods of approximating the deflections and moments occurring in a rectangular cantilever plate subject to uniform normal pressure over its entire surface are presented in this paper. The first is the application of the well-known finite-difference procedure. The second and third are collocation methods, one based upon polynomial solutions of the Lagrange equation, the other employing "mixed" hyperbolic-trigonometric terms satisfying this equation. In the last two methods the boundary conditions are satisfied exactly along the clamped edge and at a finite number of points along the free edges of the plate. The results obtained for the particular case of a cantilever plate with uniform normal load indicate that the use of a relatively small number of points in the collocation method yields values of deflections and moments that are in substantial agreement with those given by the finite-difference procedure. It can not be concluded from these results that the collocation method using the assumed functions will give satisfactory results with fewer points than the finite-difference method for cantilever plates with loading different from the one investigated.

**Approximate Approach for Torsion Problem of a Shaft With a Circumferential Notch,** by H. Ōkubo, Institute of High Speed Mechanics, Tōhoku University, Sendai, Japan. 1951 ASME Annual Meeting paper No. **51—A-16** (in type; to be published in the *Journal of Applied Mechanics*).

THE torsion problem of a bar with varying circular section has been treated by several investigators over a long period. Usually, the solution covering all points in a shaft is found first and then the maximum stress is obtained. Accordingly, the analysis usually becomes complicated and so only a few cases have been treated completely. It is essential from the technical point of view, however, to find the stresses around a notch rather than the stresses at every point in a shaft. The approach employed in this paper is somewhat different from others, and the approximate values for the stresses on the surface of a shaft are found directly without solving the problem completely.

**Stresses and Deformations of Toroidal Shells of Elliptical Cross Section,** by R. A. Clark, Case Institute of Technology, Cleveland, Ohio, T. I. Gilroy, Creighton University, Omaha, Neb., and E. Reissner, Jun. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1951 ASME Annual Meeting paper No. **51—A-11** (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper is concerned with the application of the theory of thin shells to several problems for toroidal shells with elliptical cross section. These problems are as follows: (*a*) Closed shell subject to uniform normal wall pressure. (*b*) Open shell subject to end bending moments. (*c*) Combination of the results for the first and second problems in such a way as to obtain results for the stresses and deformations in Bourdon tubes. In all three problems the distribution of stresses is axially symmetric but only in the first problem are the displacements axially symmetric.

The magnitude of stresses and deformations for given loads depends in all three problems on the magnitude of the two parameters $bc/ah$ and $b/c$ where $b$ and $c$ are the semiaxes of the elliptical

section, $a$ is the distance of the center from the axis of revolution, and $b$ is the thickness of the wall of the shell. For sufficiently small values of $bc/ab$ trigonometric series solutions are obtained. For sufficiently large values of $bc/ab$ asymptotic solutions are obtained. Numerical results are given for various quantities of practical interest as a function of $bc/ab$ for the values 2, 1, $^1/_2$, $^1/_4$ of the semiaxes ratio $b/c$. It is suggested that the analysis be extended to still smaller values of $b/c$ and to cross sections oth than elliptical.

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**Heat-Exchanger Tube-Sheet Design—2 Fixed Tube Sheets,** by K. A. Gardner, Mem. ASME, The Griscom-Russell Company, Massillon, Ohio. 1951 ASME Annual Meeting paper No. **51—A-38** (in type; to be published in the *Journal of Applied Mechanics*).

IT is shown that "fixed" tube sheets may be designed in exactly the same manner as "floating" tube sheets with the same boundary restrain, provided that a fictitious uniform "equivalent design pressure" is used in the calculations instead of the actual hydrostatic pressure. This equivalent pressure is evaluated in terms of tube-side pressure, shell-side pressure, differential thermal expansion, and the condition of boundary restrain. The design factors for all tube sheets presented in an earlier paper are shown to be well represented by very simple expressions when the fundamental design parameter $x_a$ becomes large.

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**Torsion of Curved Beams of Rectangular Cross Section,** by H. L. Langhaar, Mem. ASME, University of Illinois, Urbana, Ill. 1951 ASME Annual Meeting paper No. **51—A-14** (in type; to be published in the *Journal of Applied Mechanics*).

RECENTLY, W. Freiberger obtained an exact solution of the problem of uniform torsion of a segment of a ring of circular cross section. This paper presents a solution of the problem for the rectangular cross section. O. Göhner previously treated this case by an approximation method.

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**On Symmetrical Strain in Solids of Revolution in Spherical Co-Ordinates,** by Chih-Bing Ling and Kuo-Liang Yang, Aeronautical Research Laboratory, Taiwan, China. 1951 ASME Annual Meeting paper No. **51—A-1** (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper presents the expressions for the displacements and stresses in the spherical co-ordinates, in terms of a stress function, for a solid of revolution in the state of symmetrical strain. Such expressions are useful in dealing with solids of revolution, which consist of spherical boundaries. The expressions are applied, as an illustration, to find the stresses in a large tension member having a spherical cavity. The required stress function is constructed in terms of Legendre polynomials. It may be interesting to compare this solution with the known solutions.

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**Partially Plastic Thick-Walled Cylinder Theory,** by M. C. Steele, University of Illinois, Urbana, Ill. 1951 ASME Annual Meeting paper No. **51—A-25** (in type; to be published in the *Journal of Applied Mechanics*).

PREVIOUS theories for partially plastic thick-walled cylinders under internal pressure are reviewed. A quantitative comparison is given for (*a*) compressibility versus incompressibility of material, and (*b*) von Mises' versus Tresca's theory of failure. The former reveals that deflections at the outside and bore surfaces agree closely, although considerable percentage differences may be found in the axial stresses and strains. Large differences (except for the axial stress) are found in comparing the two theories of failure. Based on the comparison and available experimental evidence, a theory is presented in closed form to include the Hencky stress-strain relations, incompressibility, and Ludwik's strain-hardening function.

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**The Theory of Plasticity Applied to a Problem of Machining,** by E. H. Lee, Mem. ASME, Brown University, Providence, R. I., and B. W. Shaffer, Jun. ASME, New York University, New York, N. Y. 1951 ASME Annual Meeting paper No. **51—A-5** (in type; to be published in the *Journal of Applied Mechanics*).

THE recently developed methods of analyzing stress and strain distributions in the plane plastic flow of an ideally plastic material are applied to the problem of machining. It is shown that the idealized stress-strain relationship involves justifiable assumptions for this application. Analytical expressions are obtained for orthogonal machining which give the machining force, the chip thickness, and the chip deformation in terms of the tool geometry, the relevant coefficients of friction, and the appropriate yield stress of the work. With increasing friction at the tool face or decreasing rake angle the development of a built-up nose arises naturally as a consequence of the analysis. The theory includes this phenomenon. The results of this theory are compared with published experimental results, and with other theoretical analyses. Satisfactory agreement with experiment is obtained.

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**The Safety Factor of an Elastic-Plastic Body in Plane Strain,** by D. C. Drucker, Mem. ASME, and W. Prager, Mem. ASME, Brown University, Providence, R. I., and H. J. Greenberg, Carnegie Institute of Technology, Pittsburgh, Pa. 1951 ASME Annual Meeting paper No. **51—A-3** (in type; to be published in the *Journal of Applied Mechanics*).

EXTREMUM principles are established for the safety factor of an elastic-plastic body made of a Prandtl-Reuss material and subjected to given surface tractions under conditions of plane strain. Since one of these principles establishes a maximum and the other a minimum property of the safety factor, it is possible to establish bounds for the safety factor by the joint use of these principles.

# *Railroads*

**Highway Trailer Rail Service,** by G. L. Goebel, New York, New Haven and Hartford Railroad Company, New Haven, Conn. 1951 ASME Annual Meeting paper No. **51—A-82** (mimeographed).

RAIL service for transporting conventional-type semi-highway-trailer bodies was inaugurated in December, 1937, by the New Haven Railroad. Basically, the system employed on the New Haven is predicated on serial end loading of conventional-type highway semitrailer bodies on flat cars. This type of loading was chosen at the time because of low initial cost of providing necessary terminal facilities and low cost of fitting up the flat cars. Furthermore, since this was a new type of transportation on the New Haven and the potential volume of business unknown, it was deemed advisable by the management to inaugurate this rail service on a conservative basis and watch its progress and the reactions of motor carriers and shippers to the type of service offered.

While the type of car equipment used and the methods employed to safely transport conventional highway semitrailers, as outlined in the paper, may be deemed elementary in basic design and thought, the system has proved itself practical and economical in meeting the needs of motor carriers and shippers in New England and New York State and represents a considerably smaller capital investment for railroads to consider than other systems investigated, if similar business is available in other localities throughout the country.

As an indication of what the future may hold for railroads interested in this form of transportation, it is well to point out the new truck mileage tax which went into effect in New York State on October 1, 1951. Under this tax law, truckers or motor carriers must obtain a highway use permit and plate for every vehicle having a maximum gross weight of more than 18,000 lb, which will operate on New York streets and highways. In addition, each carrier must file a monthly mileage tax return and pay a tax based on maximum gross weight and number of miles operated in the state at graduated rates ranging from 0.6 cents per mile to 2.4 cents per mile. A new Truck Mileage Bureau has been set up by the State Tax Commission to administer this tax. Studies of the effect of this tax by motor carriers indicate their operating costs may be increased considerably.

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**Highway Trailers on Railroad Flatcars From the Traffic Viewpoint,** by H. R. Sampson, Chicago and Eastern Illinois Railroad, Chicago, Ill. 1951 ASME Annual Meeting paper No. **51—A-77** (mimeographed).

THIS paper discusses the new-old idea of moving motor-carrier trailers in railroad flatcars—new in the sense that few know of or are acquainted with the operation; and old since experience with this type of service dates from 1926 when the Chicago North Shore and Milwaukee pioneered in this field by offering an L.C.L. service moving for its own convenience by the utilization of railroad-owned semitrailers loaded in flatcars.

Charges for this service are reasonable and made attractive to the motor carrier inasmuch as the charges which are customarily stated on a per trailer basis are computed on the motor carrier's over-the-road costs obtained from I.C.C. sources. No attempt is made to classify the contents of the trailers but the motor carrier certifies to the fact that no contraband is located therein.

Commodities usually excluded are, for example, livestock, jewelry, valuables, coal, coke, etc. Empty returned trailers are charged just one half the amount charged for loaded trailers.

The fact that this traffic moves in the regularly scheduled through freight trains, requires no absorption of foreign line switching, is usually a two-way loaded movement, and has little or no claim payments, indicates the probably low cost of operation and the resultant profitableness.

# *Petroleum Technology*

**Recent Experience in Examination of High-Temperature Catalytic-Cracking Pressure Equipment,** by D. B. Rossheim, Mem. ASME, J. J. Murphy, R. H. Caughey, and W. B. Hoyt, M. W. Kellogg Company, New York, N. Y. 1951 ASME Annual Meeting paper No. **51—A-26** (mimeographed).

THE results of some examinations made since the beginning of 1951 on pressure equipment operating at high temperatures in fluid catalytic-cracking units are presented. The paper also discusses the possible causes of cracking discovered in three integral-clad reactors, describes the extent of graphitization found in this equipment, and offers suggestions concerning existing high-temperature equipment and projected new construction.

On February 8, 1951, a leak developed in the reactor of a fluid catalytic-cracking unit constructed of Type 347 integral-clad carbon steel after 53,000 hr operation at 900 to 975 F. Examination disclosed a crack adjacent to and paralleling a longitudinal weld. Further examination disclosed numerous cracks of a similar type in the carbon steel at welds throughout the vessel, as well as cracks in the inside alloy weld deposits. Examination of samples cut from the vessel revealed the carbon-steel base metal to be graphitized. The graphite was nodular and, in general, uniformly distributed. A tendency toward local concentrations was evident, at heat-affected zones, but only one sample showed graphite approaching a chain type; no "eyebrow" type formations were observed. The findings of investigations made on these three and other reactors, both clad, lined, and unlined, in similar service are reported. The results of mechanical tests and microscopic examinations made on specimens removed from reactors and other high-temperature equipment in the same service are presented. Possible causes of the cracks are discussed with particular emphasis on the role of thermal stresses in bimetallic construction and the effect of graphite on mechanical properties.

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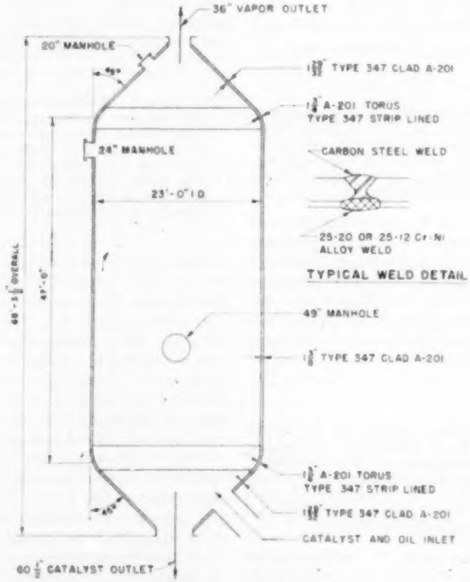
**Design and Development of High-Pressure Injection Pumps for Hydrogenation Service,** by J. T. Donovan, B. H. Leonard, Jun. ASME, and J. A. Markovits, Mem. ASME, Bureau of Mines, Louisiana, Mo. 1951 ASME Annual Meeting paper No. **51—A-71** (mimeographed).

MOST of the high-pressure equipment in the Coal-Hydrogenation Demonstra-




TYPICAL CLAD REACTOR

tion Plant was discussed in papers presented at the 1949 ASME Petroleum Mechanical Engineering Conference. The high-pressure injection pumps, however, received only passing mention at that meeting. Early operation experience was reported at the 1950 ASME Fall Meeting, and later operations yielded enough data to warrant discussion of their performance and subsequent improvement. The difficulties encountered in raising fluid pressures in a single stage from atmospheric to 10,000 psi are particularly severe when continuous operation must be maintained for extended periods. Pump designs satisfactory for the 4000 to 6000-psi range have features that definitely limit their life in continuous service at 10,000-psi discharge pressures. The original high-pressure injection pumps were direct adaptations of lower-pressure designs, and their behavior in operation proved to be far from satisfactory. Subsequent design changes and improved material specifications have greatly increased the life of these pumps, and an entirely new design has been developed that incorporates all features essential to reliable and economical service.

This discussion treats the mechanical problems encountered in the continuous pumping of fluids and fluids containing solids at high pressure, the mechanical failures that occurred, the corrective measures taken, and the design features that are essential for a satisfactory high-pressure pump. Theory has been kept to a minimum, and a concerted effort has been made to base the discussion on factual demonstration-plant experience.

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**Some Kinematic Aspects of Pumping-Unit Mechanisms,** by E. N. Kemler and R. J. Howe, University of Minnesota, Minneapolis, Minn. 1951 ASME Petroleum Mechanical Engineering Conference paper No. **51—PET-14** (mimeographed).

THE basic mechanism used in sucker-rod pumping units dates back to the days of Watt and his steam engine. This crank-pitman-walking-beam mechanism is also known as a four-bar linkage (occasionally called three-bar linkage). The conventional treatment of kinematic problems associated with this mechanism, as well as with mechanisms in general, utilizes graphical methods. For many purposes, graphical methods are entirely satisfactory, although the accuracy is dependent on drafting limitations and depends largely on the drafting skill of the man making the layout. Where accuracy of solution is involved, analytical methods are necessary if available. This paper gives an analytical method for obtaining walking-beam position in terms of the driving-crank position. This information can be used to find polished-rod motion in terms of crank angle or position.

This paper discusses the general application of the analytical method to study of pumping-unit problems. Examples of application of the method to determination of polished-rod displacement are given. Tabulated values of various factors involved in these calculations are included to simplify the actual numerical work. These were made using the IBM calculating punch of the Institute of Technology's Computing Center. When reduced to this basis, it is often easier and quicker to carry out an exact numerical calculation than to do a graphical solution for certain conditions. The paper also discusses the application of harmonic analysis to certain pumping-unit problems. A brief discussion of the application of harmonic analysis to the study of such kinematic problems as shifting of crank centers is included.

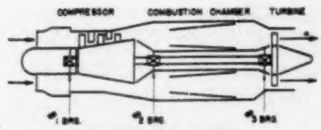
# *Aviation*

**Some Performance Characteristics of Ball and Roller Bearings for Aviation Gas Turbines,** by John Boyd, Mem. ASME, and P. R. Eklund, Westinghouse Research Laboratories, East Pittsburgh, Pa. 1951 ASME Annual Meeting paper No. **51—A-78** (mimeographed).

AMONG the many problems encountered in connection with the development of gas turbines for the U. S. Navy Bureau of Aeronautics was that of establishing whether commercially available bearings would be suitable or if certain changes would be necessary. This involved a determination of bearing-performance characteristics under a wide range of conditions. Complicating the problem was the necessity of securing this information with the least possible delay.

While sleeve [illegible] were employed on the first u[illegible]s early realized that for mili[illegible]poses, ball and roller bearings w[illegible]d have three important advantages: (1) Lower friction on cold starting; (2) ability to run longer in case of an interruption in the lubricant supply; and (3) less possibility of bearing damage during starting, at which time the oil pump is not yet up to speed.

Whether these advantages could be realized, however, was obscured by the general lack of information on permissible speeds, loads, and temperatures. To obtain the answers to these questions, an extensive test program was undertaken. Some of the results of this investigation are presented in this paper.




TYPICAL BEARING ARRANGEMENT IN AIRCRAFT GAS TURBINE

The field tests conducted and design changes introduced succeeded in transforming the bearings from a relatively critical component in an aircraft gas turbine to one which is now as reliable as the other engine parts.

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**The Life of High-Speed Ball Bearings,** by A. B. Jones, The Fafnir Bearing Company, New Britain, Conn. 1951 ASME Annual Meeting paper No. **51—A-69** (mimeographed; to be published in Trans. ASME).

MODERN jet-engine requirements have resulted in the application of large ball bearings for heavy loads at very high speeds. Conventional calculations of bearing life are based on the fatigue of the components due to the externally applied loads. At high speed the centrifugal force on the balls increases the probability of failure of the outer race in the case of radial-type ball bearings under radial load and hence reduces bearing life.

In angular-contact bearings operating under thrust load, centrifugal loading of the balls tends to produce a higher operating contact angle for the inner race than the outer. Thus the relative probabilities of outer and inner-race failure are different from those calculated from static loading and bearing life is accordingly different. The theoretical conditions outlined in this paper have not been confirmed by a formal series of life tests.

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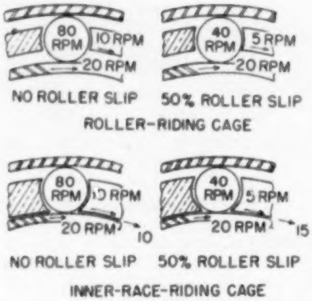
**Operating Characteristics of Cylindrical Roller Bearings at High Speeds,** by E. F. Macks, Jun. ASME, Z. N. Nemeth, and W. J. Anderson, NACA, Lewis Flight Propulsion Laboratory, Cleveland, Ohio. 1951 ASME Annual Meeting paper No. **51—A-66** (mimeographed; to be published in Trans. ASME).

THE high-speed aspect of bearings, in general, is discussed so as to establish a perspective of where the problem stands with respect to present and future service requirements. The significance of the bearing operating temperature is discussed with regard to bearing operating limitations. The extent of the effects of speed, load, oil flow, oil-inlet temperature, oil-inlet velocity, and oil viscosity




EFFECT OF ROLLER SLIP ON HEAT GENERATED WITHIN TWO CAGE-TYPE BEARINGS

upon the bearing inner and outer-race temperatures is shown.

It is pointed out that roller slip occurred in high-speed roller bearings, and that there is a fundamental difference in the operating characteristics of certain types of high-speed bearings heretofore considered to be essentially equivalent. Oil-inlet distribution was also found to be a significant factor regarding the control of bearing operating temperature. Test-rig results as well as turbo-jet-engine data have been generalized by means of dimensional analysis to allow the designer to predict the bearing temperature rise from a single curve regardless of whether bearing speed, bearing load, oil flow, oil-inlet temperature, oil-inlet velocity, or oil-inlet viscosity vary over wide ranges.

# *Machine Design*

**Contributions to Hydraulic Control 1—Steady-State Axial Forces on Control-Valve Pistons,** by Shih-Ying Lee and J. F. Blackburn, Massachusetts Institute of Technology, Cambridge, Mass. 1951 ASME Annual Meeting paper No. **51—A-52** (in type; to be published in Trans. ASME).

A THEORY is given of the origin of the steady-state force exerted upon a piston by fluid flowing past its corner, brief reference is made to a considerable body of experimental evidence in support of that theory, and a practical valve construction is described which very nearly eliminates that force.

**Contributions to Hydraulic Control 2—Transient-Flow Forces and Valve Instability,** Shih-Ying Lee and J. F. Blackburn, Massachusetts Institute of Technology, Cambridge, Mass. 1951 ASME Annual Meeting paper No. **51—A-60** (in type; to be published in Trans. ASME).

AN outline is presented of a theory of a transient force which is one likely cause of oscillation of control valves, with supporting experimental evidence and methods of eliminating it.

**Hysteresis of Shaft Materials in Torsion,** by W. P. Welch, Jun. ASME, and B. Cametti, Westinghouse Electric Corporation, Pittsburgh, Pa. 1951 ASME Annual Meeting paper No. **51—A-64** (in type; to be published in Trans. ASME).

STATIC determinations of hysteresis of typical shaft materials in torsion show that the values are low for high-quality materials in unidirectional loading after several cycles of loading up to a shear-stress amplitude of 24,000 psi. For reversed loading, the hysteresis becomes several times larger and may be of significance in accurate torque-weighing devices. The measured hysteresis in a tubular specimen had values 3 to 4 times that for a solid specimen. Two nonmagnetic materials displayed very low values of hysteresis. The apparatus developed for this investigation had sensitivity sufficient to measure displacement changes of 0.002 per cent of the full load deflection, and was designed to eliminate errors due to temperature changes, extraneous loads, and external vibration.

**Design of Flat-Wound Tension Springs,** by R. M. Conklin, Mem. ASME, and D. R. Forry, Battelle Memorial Institute, Columbus, Ohio. 1951 ASME Annual Meeting paper No. **51—A-59** (in type, to be published in Trans. ASME).

THE design of spring-actuated mechanisms often can be improved by the use of a flat-wound spring. Over-center snap action and similar devices, where it is advantageous to keep the line of action of the spring as close to the bearings as possible, can be made appreciably more compact because of the narrow width of the spring. Equations for the deflection and stress of flat-wound springs are developed. A nomogram, which can be used to solve the stress and deflection equations simultaneously for square and round wire springs, is presented. Experimental results which support the theoretical analysis have been obtained and are discussed in detail.

**Bolt Elongations and Loads,** by Leonardt F. Kreisle, Jun. ASME, and Joseph B. Oliphant, The University of Texas, Austin, Texas. 1951 ASME Annual Meeting paper No. **51—A-49** (mimeographed).

THIS paper is a rationalization of the general bolt problem showing the relationship of the interaction of the mating threads, the elongation of the unmated threaded shank, the elongation of the threaded shank, the magnitude of the applied load, the number of load applications, the bolt size, the thread type, and the gasket effects.

Equations are derived to predict the total elongation of a bolt corresponding to a desired total load in the bolt and to predict the total load in a bolt for a given set of conditions.

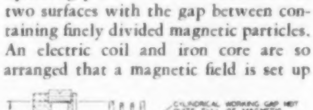
The effective cross-sectional area of the unengaged threaded shank is investigated and experimentally is found to be close to the root area.

An elongation factor $\beta$ and an interaction factor $m$ are defined and methods are presented for calculating $\beta$ and $m$ in terms of known dimensions and experimentally determined values. The effects of load variations and number of load applications on the interaction of mating threads are investigated and experimentally determined values of $m$ are presented by use of curves.

Starting with a standard bolted joint employing a gasket, a bolt-gasket factor $k$ is defined. Equations are developed for calculating the value of $k$ in terms of $m$ and the physical properties and dimensions of the members.

**The Magnetic-Particle Clutch,** by P. H. Trickey, Vickers Incorporated, St. Louis, Mo. 1951 ASME Annual Meeting paper No. **51—A-50** (mimeographed).

DURING the last three years the magnetic-particle clutch has progressed through development and engineering and the major engineering problems appear to have been solved. The basic operating part of this clutch consists of two surfaces with the gap between containing finely divided magnetic particles. An electric coil and iron core are so arranged that a magnetic field is set up




CROSS SECTION OF VICKERS MAGNECLUTCH USED ON A 5-KW 3400-RPM MOTOR GENERATOR SET

in the gap. When current flows through the coil the magnetic particles form chains between the surfaces and hold them together. The shear force is approximately proportional to the current.

The clutch has the unusual feature that the slipping and locked-in torque are the same for any given current, giving smooth operation. Due to the lack of wear, the clutches have been successfully used under continuous slip operation. Centrifugal flingers, O-rings, saturable bridges, and stationary excitation members have overcome most of the early obstacles in design. There appear to be no inherent design limitations regarding size, and clutches have been developed up to several hundred horsepower.

The United States Navy believed that this type of clutch had great possibilities and awarded contracts to Vickers Electric Division involving several sizes. The clutch in these cases was to function as a coupling between a 60-cycle driving motor and a 400-cycle alternator. It was to slip at any point from 1 to 9 per cent and, by means of a special static controller, was to hold the generator speed constant over a range of drive motor voltage and frequency, regardless of load on the generator.

# *Fuels Technology*

**Thermodynamics of Gasification of Coal With Oxygen and Steam,** by Wayne C. Edmister, Mem. ASME, Carnegie Institute of Technology, Pittsburgh, Pa., Harry Perry, and R. C. Corey, Mem. ASME, Bureau of Mines, Pittsburgh, Pa., and M. A. Elliott, Mem. ASME, Office of Synthetic Liquid Fuels, Bruceton, Pa. 1951 ASME Annual Meeting paper No. **51—A-20** (in type; to be published in Trans. ASME).

THERMODYNAMIC charts and tabulations are presented for calculating conveniently the heat balance, and product-gas yield and composition for the gasification of coal with oxygen and steam, on the assumption that water-gas shift equilibrium is attained by the product gases. These charts are of general applicability for any rank of coal; they cover a wide range of operating conditions through the use of multiple parameters, and may be used for pressures as high as 30 atm. Examples are given to illustrate the use and versatility of the charts. Charts and numerical examples are also given for a typical high-volatile C bituminous coal to illustrate the uses of such charts for a specific coal.

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**Flow and Combustion Stability,** by N. P. Bailey, Fellow ASME, Rensselaer Polytechnic Institute, Troy, N. Y. 1951 ASME Annual Meeting paper No. **51—A-83** (mimeographed).

THE mechanical-engineering interest in combustion prior to 1925 was primarily concerned with the construction of combustion equipment and standardization tests of fuels. Between 1925 and 1940 the elementary physical chemistry of hydrocarbon fuels and the thermodynamics of chemical equilibrium became popular areas of mechanical-engineering study. The past decade has been marked by the need for modulated or variable-load combustion for gas turbines, turbojets, rockets, and ramjets. This has done much to focus the attention of mechanical engineers on an area where they must make a unique contribution to the art and science of combustion.

For a combustion system to operate satisfactorily over a wide range of loads and temperatures all of the elements of the system must be designed in balance and controlled in a manner to produce a stable system. With improper design balance and control a rough-burning or even completely unstable system can result.

The surging, pulsation, and blowout of semistable and unstable flow and combustion systems has been a rather neglected area of mechanical-engineering technology. These are fully discussed in the paper. Noise is the most characteristic thing about recent high-velocity and high-energy-release combustion developments and noise is produced only by unsteady systems.

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**Photographic Analysis of Sprays,** by J. Louis York, Jun. ASME, and H. E. Stubbs, University of Michigan, Ann Arbor, Mich. 1951 ASME Annual Meeting paper No. **51—A-48** (mimeographed).

THE study of sprays and their properties has been hampered by difficulty in obtaining trustworthy measurements of the number, sizes, and velocities of drops at various locations within a spray. Many attempts to evaluate the character of a spray have been concerned only with the distribution of the flow and give no information about the drops. An example is the patternator, which operates with cups placed at various locations in the spray. After the spray fills the cups, the contents of each cup, for some period of time, can be measured to evaluate the flow rate at that location. Other methods of analysis attempt to measure the number and size of the drops of a spray. Most of these depend on physical sampling of the spray or on the scattering of light by the spray. Physical sampling is usually accomplished by having drops impinge on cups or microscope slides in the spray or by sucking them out of the spray through a tube. The captured sample can then be analyzed leisurely for number and size of drops. These procedures are untrustworthy because it is questionable if the sample analyzed is representative of the original spray. Analyses based on light scattering are free of the bias arising from impingement, but the interpretation of light-scattering data is extremely difficult when the drops of the spray are not in a very narrow range of sizes. Furthermore, any interpretation depends on a long chain of theory containing questionable assumptions. None of these methods gives any information about drop velocities.

This paper describes an experimental method for determining the size distribution and velocities of drops in a spray. Photographs are taken of a small known volume of the spray, and the images of the drops are counted and measured to give the size distribution. Velocities are determined by taking two exposures on the same film and measuring the displacement of the drops in the interval between exposures. Since a photographic method does not require any objects in the spray, the results are free of bias from disturbances of the flow pattern. The technique is applicable to sprays in which the diameters of drops range from 15 to 500 microns and gives results which differ by less than 20 per cent from the metered values of total flow rate.

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**Fuel and Engineering Consulting Service for Small Plants,** by H. C. Carroll, Carroll, Bechtel, and Langtry, Chicago, Ill. 1951 ASME-AIME Joint Fuels Conference paper No. **51—FU-1** (mimeographed).

THE range of small steam plants is defined. According to the paper, the reasons why consulting service is not more often employed are: (1) Architects are usually called in first and they include mechanical-engineering service, (2) cost of solicitation is high due to number of plants involved, (3) free advice is given by equipment representatives and steam-plant contracting concerns. Normal consulting service is outlined for economical layout and operation and the importance of a preliminary survey is emphasized. The economic study of each case is a function of the consulting engineer. Economic position of coal as fuel

now and in the forseeable future is discussed. It is pointed out that fuel data by consuming areas is needed. Small plant owners need consulting service to meet increasing operating costs. The consultant's additional services are cited.

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**Fuel and Engineering Consulting Service for Small Plants,** by Albert R. Miller, Mem. ASME, General Foods Corporation, New York, N. Y. 1951 ASME-AIME Joint Fuels Conference paper No. **51—FU-2** (mimeographed).

IN order to obtain a better understanding of the small plant owners' viewpoint, a survey of the existing equipment and operating costs of a group of plants is set forth. To assist in arriving at equipment designs, mention is made of a few conditions peculiar to these plants, several cardinal design factors, the use of standardized units and importance of plant surveys, studying steam utilization as well as steam generation.

It is pointed out that the yearly fuel bill in steam plants of between 5000 and 50,000 lb per hr installed capacity is relatively small and expenditures aimed solely at increasing the unit efficiency are usually not economically attractive. Assuming full-time operating attendance, which is usually necessary and advisable, the operating labor cost averages over 50 per cent of the fuel bill and expenditures for coal-handling equipment are justifiable to eliminate the necessity of a second operator on a shift.

The new unit should be flexible and reliable, being capable of handling low loads and fluctuating steam demands with a minimum of maintenance. The importance of preventive maintenance must be stressed upon the plant supervisors.

The boiler unit in an entirely new factory receives sufficient engineering study, but additions to existing plants and replacement units can benefit by more unbiased engineering attention.

Plant surveys, including steam utilization and heat-balance studies, should precede any new installation as there are many possible economically justifiable alterations in the steam users, which, if made, can appreciably decrease the needed capacity of the new unit or occasionally eliminate the necessity of the installation entirely.

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**Engineering Service in the Coal Industry,** by U. B. Yeager, Mem. ASME, Island Creek Coal Sales Company, Huntington, W. Va. 1951 ASME-AIME Joint Fuels Conference paper No. **51—FU-3** (mimeographed).

THIS paper points out the direct functions and associated activities of the service, combustion, and/or fuel engineers of coal-producing or selling companies in the application and utilization of coal by and to industries dependent upon coal for their source of fuel.

The service, combustion, or fuel engineer of coal-producing or selling companies must translate the known policies of his company as best he can to bridge the gap between the needs of the sales staff and the known requirements of the prospective consumer. His work is to make recommendations and then after these recommendations have been approved, and possibly established as a platform of policy, to translate these recommendations and policies into actual operations.

Through the application of such engineering principles as may be applied, the over-all problem of the prospect is studied. The scope of this activity might be divided into four parts: (1) A survey shows the equipment and operating conditions which are to be met. (2) An analysis of these various factors points the way to the recommendations which should be made for the coal application and from these a sales proposal can be prepared for submission to the prospective consumer. (3) The prime concern of a buyer is the cost price. The prime concern of the salesman, normally, is the selling price, and the prime concern of the engineer is the use value. It, therefore, falls largely to the engineer that the three main concerns are equated and the relative values of the competing fuels are established. (4) Assuming that the proposal meets with a favorable reception, it is then the work of this engineer to work again with still another group—the operating group of the consumer or prospect.

When his work has been properly applied and when he has received a reasonable degree of co-operation, the engineer can bring to the potential consumer, generally, a substantial saving in his cost of operation, possibly not from the application of coal alone, but from improvements in operating methods and techniques.

The fuel engineers of the coal companies and of the companies closely allied to the coal industry largely have been responsible for or have pointed the way to a vast amount of research and development. This work has been the outgrowth of engineering investigations carried on in the normal course of their work. Various work which has been done on some of these programs include: The study and application of overfire air in the combustion process; the pulverized-coal gas turbine for locomotive use; the study of fuel beds, especially of underfeed stokers; the preparation of coal and its consist toward its greatest use value; the application of coal to meet the requirements made necessary in the by-product carbonization for the steel industries; a study of slag formation; the chemical treatment of coal; and many others.

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**Engineering Service in the Coal Industry,** by M. A. Tuttle, Enos Coal Mining Company, Indianapolis, Ind. 1951 ASME-AIME Joint Fuels Conference paper No. **51—FU-4** (mimeographed).

THE prime requisites for successful fuel and engineering service according to the paper are:

1 The ability to read and properly analyze a fuel bed and flame line without the use of instruments.

2 The knack of getting along with people and of varying your line of reasoning and your choice of language from the president's office to the coal passers' whims and personal interests. Also to appreciate the limitations of plant equipment and personnel and realize acceptable efficiency and performance.

# *Lubrication*

**Effect of Variations in Viscosity of Lubricants Upon Timken OK and Psi Values,** by I. S. Kolarik, C. A. Zeiler, and E. M. Kipp, Aluminum Company of America, New Kensington, Pa. 1951 ASME Annual Meeting paper No. **51—A-35** (in type; to be published in Trans. ASME).

THE Timken lubricant tester is often used in the laboratory in establishing Timken OK loads and psi values at OK loads for lubricants of the extreme-pressure type, particularly for those used as gear lubricants. The present investigation was conducted to determine the magnitude of hydrodynamic lubrication effects associated with viscosity in determining OK loads. The effect of rubbing speeds was also studied.

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**Oil Flow in Plain Journal Bearings,** by S. A. McKee, National Bureau of Standards, Washington, D. C. 1951 ASME Annual Meeting paper No. **51—A-34** (in type; to be published in Trans. ASME).

AN analysis is given of the factors affecting the leakage of oil from the ends of plain journal bearings fed either through an oilhole or an axial groove on the unloaded side, or a circumferential groove. With bearings having an oil or an axial groove, the oil flow con-

sists of two components, one resulting from the oil-feed pressure, and the other from the hydrodynamic-film pressures supporting the load. For bearings having a circumferential groove, the flow is primarily from the oil-feed pressure. The data given indicate that for any given bearing the oil flow may be expressed in terms of two dimensionless factors involving the oil-feed pressure and the bearing load. The relations between these factors and the generalized operating variable, $\mu N/P$, are given for bearings having each of the three designs of oil feed. Further investigations are suggested to provide a more complete understanding of the factors affecting end leakage of oil from plain journal bearings.

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**On the Solution of the Reynolds Equation for Slider-Bearing Lubrication,** by A. Charnes and E. Saibel, Mem. ASME, Carnegie Institute of Technology, Pittsburgh, Pa. 1951 ASME Annual Meeting paper No. **51—A-43** (in type; to be published in Trans. ASME).

AN exact solution is developed for the Reynolds equation in the hydrodynamical theory of slider-bearing lubrication with side leakage for film thickness varying exponentially. This solution is in the form of a rapidly convergent series from which calculations for the pressure distribution, total bearing load, and center of pressure may be made rapidly for all values of the parameter concerned. The results are in close agreement with those which have been obtained for the plane slider bearing by cumbersome methods, and it is proposed not only to use the present solution for the plane case, but also to show the design possibilities for a much wider variety of shapes by using various portions of exponential curves.

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**Oil Flow, Key Factor in Sleeve Bearing Performance,** by Donald F. Wilcock, Mem. ASME, and Murray Rosenblatt, General Electric Company, Schenectady, N. Y. 1951 ASME Annual Meeting paper No. **51—A-89** (mimeographed).

THE determination and understanding of the performance characteristics of cylindrical sleeve bearings is based on the following three relationships: (1) The viscosity-temperature characteristics of the lubricant; (2) the bearing power consumption as a function of oil film temperature; and (3) the oil flow through the bearing as a function of Sommerfeld number. The first two are well known, and this paper is concerned primarily with the nature and quantitative determination of oil flow, together with the simplified methods for the calculation of bearing performance made possible thereby.

The discussion is restricted to those bearings having oil fed under pressure to their oil distribution grooves. Oil flows from the ends of these bearings because of the pressure in the oil grooves and because of the pressures generated in the load-carrying portion of the oil film. The second type of flow is dependent upon shaft speed. Dimensionless parameters controlling both types of flow have been calculated, and experimental results on several bearing sizes confirm the theory.

A detailed study of the circumferential flow of oil in the bearing shows that Petroff's law is an excellent approximation of power loss up to an eccentricity of 0.7, and that the temperature variation in the oil film may be estimated with simple assumptions.

Knowledge of bearing oil flow characteristics permits the ready calculation of bearing performance by means of the "Operating Line Method."

# *Management*

**Incentives for Better Production Effectiveness,** by Phil Carroll, Fellow ASME, Maplewood, N. J. 1951 ASME Annual Meeting paper No. **51—A-21** (mimeographed).

People like to excel. They want to know how they compare with others. And according to the experts, people like to work when they know what they are supposed to do and get credit for doing it.

Under good wage incentive people get measurement of their work performances. They know where they stand relative to the others. Such measures are objective and can be used constructively in any form of merit rating.

People work for recognition, for status, and to "get ahead." At the same time they say, "a title without a raise doesn't buy the baby any shoes." So we have to think of the money rewards. Put another way, work measurement without wage incentive is restrictive.

Whether we look at indirect or direct operations, we must consider the incentives in suggestion awards.

Suggestions help to attain our objective in two ways. One is the obvious improvement in productivity. The other is the likelihood of strengthening the feeling of participation.

If incentives are good for some, they are good for all. We need more incentives to bring out the best in people. We should take positive action to offset the trends toward leveling everybody to a common standard. Where will our future leaders come from if it isn't worth while to step out of line? Paying more money for the same performances won't do it.

We pound on the theme of better industrial relations of every conference. We repeatedly hear that we have neglected the human element in our zest for mechanization. Probably, much of this is correct advice. Also, we must recognize the differences in people that are emphasized in all of these admonitions.

## ASME Transactions for December, 1951

THE December, 1951, issue of the Transactions of the ASME, which is the *Journal of Applied Mechanics* (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

On the Inextensional Theory of Deformation of a Right Circular Cylindrical Shell, by R. M. Hermes. (51—APM-2)

The Behavior of Graphite Under Alternating Stress, by Leon Green, Jr. (51—APM-3)

Vibrations of a Clamped Circular Plate Carrying Concentrated Mass, by R. E. Roberson. (51—APM-5)

A General Method of Calculating the $M_{e_{max}}$ Diagram in Plastic Bending of Beams, by Aris Phillips. (51—APM-6)

Bending of Thin Ring-Sector Plates, by L. I. Deverall and C. J. Thorne. (51—APM-1)

On the Stability of Plates Reinforced by Longitudinal Ribs, by J. M. Klitchieff. (50—A-10)

On Symmetrical Strain in Solids of Revolution in Spherical Co-Ordinates, by Chih-Bing Ling and Kuo-Liang Yang. (51—A-1)

The Safety Factor of an Elastic-Plastic Body in Plane Strain, by D. C. Drucker, H. J. Greenberg, and W. Prager. (51—A-3)

Plastic-Wave Propagation Effects in High-Speed Testing, by E. H. Lee and H. Wolf. (50—A-35)

A New Method of Calculation of Reheat Factors for Turbines and Compressors, by Joseph Kaye and K. R. Wadleigh. (51—A-2)

The Calculated Performance of Dynamically Loaded Sleeve Bearings—III, by J. T. Burwell. (51—A-7)

The Theory of Plasticity Applied to a Problem of Machining, by E. H. Lee and B. W. Shaffer. (51—A-5)

DESIGN DATA AND METHODS

Critical Loads on Variable-Section Columns in the Elastic Range, by Gordon Silver

DISCUSSION

On Previously Published Papers by Julius Aronofsky; David Burgreen; M. V. Barton; H. D. Conway, L. Chow, and G. W. Morgan; J. M. Coan; A. C. Eringen; M. Finston; L. Green, Jr., and P. Duwez; R. H. MacNeal; L. E. Malvern; and P. S. Symonds

BOOK REVIEWS

# 1951 *An* ACTIVE YEAR *for* ASME

## *The ASME Council Summarizes Activities and Results*

THE year ending Sept. 30, 1951, was one of the most active years in the history of the Society. At the close of the period membership had grown to 36,668 Members and 13,419 Student Members, a total for all classes of membership of somewhat more than fifty thousand. This success was made possible through the co-operative and untiring efforts of the individual members of the Society and of the Society employees in the many groups into which the Society is organized.

It is fortunate indeed that a group of fifty thousand persons can work together so successfully for the common good of all mankind. The Council believes that all members of the Society merit the highest commendation for the part they have played in this good work.

#### GROWTH OF TECHNICAL LIFE

It is gratifying to report that the activities of the Society directed toward the advancement of knowledge in the field of mechanical engineering showed healthy growth and vitality. Our divisions and committees distinguished themselves not only in the traditional fields of power, fuels, applied mechanics, management, and education, and in research, standardization, and codification, but in the newer subjects of heat transfer, instruments and regulators, and gas-turbine power, and vastly improved the value and significance of the Society's work on such important matters as aviation, petroleum mechanical engineering, and machine design. Improvements in the character and quality of papers can be noted in all these fields. Better-organized material and particularly the analytical approach dependent on mathematical treatment are fast becoming characteristics of ASME papers. This trend is a distinct service to younger engineers who are well grounded in these methods, but it presents to the Society a task of interpretation for the benefit of older men with broad professional and technical interests. Related to this problem is the tendency of authors to narrow their fields of work to a point where only a limited number of experts recognize the significance of the material reported.

#### COMPLETE COMMITTEE REPORTS AVAILABLE

The reports of all ASME Boards, Divisions, Committees, and representatives on joint agencies are issued in a separate pamphlet, available on request. In this report of the Council to ASME Members, only the high lights of a few of these individual reports can be included.

#### NATIONAL JUNIOR COMMITTEE ACTIVE

Conditions in the colleges and in the nation reduced the number of Student Members of the Society, only 13,419 being enrolled during the year in the 137 Student Branches. However, additions to the youngest group of junior members showed an increase of 4217 during the year, and the activities of the National Junior Committee and the Old Guard were stepped up to aid in the more rapid advancement of these young men in their careers and in the work of the Society.

#### MEETINGS PROVIDE OPPORTUNITIES FOR MEMBERS

During the year the Meetings Committee, the Professional Divisions, the 74 Sections, 7 Sub-Sections, 1 international group in Mexico, and other Society agencies, provided 4 National Meetings, 6 Divisional Conferences, and 883 local meetings for the benefit of Members. Our 137 Student Branches held 670 meetings (28 Branches not reporting) and conducted 12 Regional Conferences at which hundreds of young men had opportunity to participate in demonstrations of the manner in which engineers exchange information for their mutual benefit.

The Engineers Civic Responsibility Committee, composed principally of ASME Past-Presidents, secured three eminent speakers to deliver the Roy V. Wright Memorial Lecture at the Spring, Fall, and Semi-Annual Meetings—Frank H. Neely, Dr. C. J. Mackenzie (president, National Research Council of Canada), and John A. Barriger. At the Fall Meeting, Dr. Frederick Oederlin, managing director in charge of engineering, Sulzer Brothers, Inc., of Winterthur, Switzerland, delivered the 1951 Calvin W. Rice Lecture. A notable Semi-Annual Meeting held at Toronto, Canada, was addressed by the Right Honorable Clarence D. Howe, Minister of the Department of Defense Production of Canada. At each of the National Meetings the National Junior Committee sponsored sessions on professional development for young engineers, and through the courtesy of the Old Guard a group of about 10 young men from the region were in attendance to lead the discussion.

The Board on Technology undertook a comprehensive study of measures to re-establish the ASME Lectures, a service to the Sections' program making.

#### NUMBER OF SESSIONS AND PAPERS GROWING

Statistics covering the National Meetings of the Society and the Divisional Conferences held during the year will be found in Table 1. It will be noted that the number of sessions and the number of papers presented continues to increase, indications of the extraordinary technical developments of our times and the virility of the activities of our members. National meetings continue to reflect the progress made by our Program Planning Conferences. Services to members are being improved by means of more complete advance programs printed in MECHANICAL

TABLE 1
LIST OF ASME NATIONAL MEETINGS AND CONFERENCES
1950–1951

| Meetings | Number of days | Number of sessions | Number of papers | Attendance |
|---|---|---|---|---|
| Fuels Conference<br>Oct. 23–25, 1950, Cleveland, Ohio | 2 | 4 | 13 | 310 |
| Annual Meeting<br>Nov. 26–Dec. 1, 1950, New York, N. Y. | 5 | 79 | 215 | 5422 |
| Spring Meeting<br>April 2–5, 1951, Atlanta, Ga. | 4 | 20 | 46 | 449 |
| Process Industries Conference<br>April 17–19, 1951, Baltimore, Md. | 3 | 6 | 14 | 171 |
| Semi-Annual Meeting<br>June 11–15, 1951, Toronto, Canada | 4 | 33 | 78 | 1153 |
| Applied Mechanics West Coast Conference<br>June 22–23, 1951, Stanford, Calif. | 2 | 4 | 14 | 64 |
| Oil and Gas Power Conference<br>June 25–29, 1951, Dallas, Texas | 4 | 8 | 18 | 309 |
| Industrial Instruments and Regulators Conference, Sept. 10–14, 1951, Houston, Texas | 2 | 3 | 6 | 350 |
| Petroleum Mechanical Engineering Conference, Sept. 24–26, 1951, Tulsa, Okla. | 3 | 16 | 40 | 410 |
| Fall Meeting<br>Sept. 26–28, 1951, Minneapolis, Minn. | 3 | 23 | 46 | 550 |
| | 32 | 196 | 490 | 9188 |

ENGINEERING and a higher percentage of papers available in preprint form—an increase of 23 per cent. President's luncheons, featured at all National Meetings to encourage all-Society participation, were well received.

###### PUBLICATION SERVICES ACTIVE

Publication services (based on 1950 calendar year) comprised 1656 pages of text in Transactions and the *Journal of Applied Mechanics;* 1014 pages of text in MECHANICAL ENGINEERING, including digests of 290 Society meeting papers; 434 pages (2840 items) in *Applied Mechanics Reviews;* 21 codes and standards (600 pages); and special publications (about 1058 pages). In addition publication was begun of Dean Dexter S. Kimball's story of his long and fruitful career. The Membership List was issued in the spring, and a Ten-Year Index of ASME publications was completed and offered for sale. Progress was made toward completion of the Metals Engineering Handbook, and indications point to publication of parts 1, 2, and 3 in 1952. Publication sales included 115,000 copies of technical papers, 50,000 of standards and codes, and 14,000 of other special publications.

###### ASME SPARKPLUGS RESEARCH

The Society continued to provide a service to industry by planning and sponsoring research on problems cutting across company and industrial lines. Cash contributions from industry and other sources for the support of this work amounted to $90,000, with contributed services, materials, and equipment valued at about the same amount. In addition to the 400 committee members, more than 200 companies participated in the program.

Progress was made on programs on high-temperature steam generation, furnace performance factors, effect of temperature on properties of metals, flow measurement, plastic flow of metals, sliding and rolling friction, lubrication, metal-cutting data, and heat conductivity of gases. Several new projects were started. The Research Committee sponsored 12 sessions at Society meetings, at which 34 papers were presented.

###### CODES AND STANDARDS ADVANCED

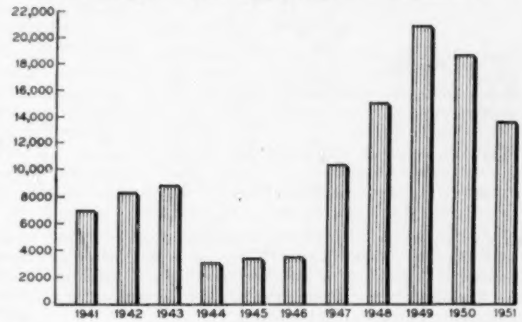
The Board on Codes and Standards reports that it approved 43 actions relating to the work and personnel of 350 committees and subcommittees under its jurisdiction, the 6 committees which ASME sponsors jointly with other organization, and the 77 ASME representatives on committees sponsored by other activities. It approved 18 codes and standards. Its activity on the international front is mentioned later in this report. The Boiler Code Committee continued its interpretations of the Code.

###### REGIONAL REPORTS SHOW INCREASED ACTIVITY

A rapidly growing membership cannot be maintained as a healthy organization on services, such as Society meetings, publications, research, standardization, and codification activities conducted solely on a nationwide basis. Activities and services on a local basis must be made available in the community where the individual member lives and works. And to provide new material for continuing progress of the Society in the future, ASME must be carried to the campuses of the engineering colleges where Student Branches have been established. These important fields of Society activity and organization are administered by the vice-presidents, one for each of the eight regions into which the nation has been divided. The vice-presidents report healthy conditions in the regions they administer.

Region I added a new Student Branch at the University of Massachusetts, Amherst, Mass., and held its Student Branch Conference at the University of Vermont. All 10 sections had active programs. The Regional Administrative Committee meeting was held at New Haven, Conn. The report on unity of the engineering profession was thoroughly studied and discussed. President Brown spent three days in the Region, visiting 8 Sections and 8 Student Branches.

A.S.M.E. STUDENT MEMBERS
(EQUIVALENT FULL-YEAR STUDENT MEMBERS)




Region II reports continued programs of a technical and social nature, with an attendance of 800 at the Spring Round-Up. Membership development was an active concern. A number of courses at the college level were offered in addition to opportunities to prepare for professional-engineer-license examinations. The Metropolitan Section collaborated with other societies in forming a Smoke Control Board and in the preparation of rules to improve air-pollution conditions in New York City. Much attention was given to the Student Branches and to the Student Council. The 1951 Student Conference was held at Stevens Institute of Technology.

High lights of the year in Region III included Junior activities, particularly in the Philadelphia Section; the Process Industries meeting sponsored by the Baltimore Section; the Regional Administrative Committee meeting at Schenectady, N. Y.; and the 1951 Student Branch Conference at the University of Pennsylvania.

Membership in Region IV increased by 19 per cent, the largest increase being reported by the Chattanooga Section which absorbed the Memphis Section. All 13 Student Branches report activity. The 1951 Student Branch Conference and the Regional Administrative Committee met at Atlanta on the occasion of the 1951 ASME Spring Meeting.

Region V reports a membership in excess of 5400 (of which 50 per cent are Junior Members), 14 Sections, and 2 Sub-Sections. During the year the Canton-Alliance-Massillon Sub-Section was given Section status, and a new Sub-Section, Jackson-Lansing-East Lansing, was organized under the Detroit Section. A Student Branch at the University of Toledo was chartered. The Student Branches Committee and the Membership Development Committee of Region V rendered constructive reports. The Student Branch Conference was held at the University of Detroit and the Regional Administrative Committee meeting at Grand Rapids, Mich. All Sections and Student Branches were visited by some officer of the Region.

Gratifying increase in membership is reported by Region VI. Joint meetings with Student Branches and cash awards for student papers were featured by most sections. The Regional Administrative Committee met at Omaha, Neb., where a unity organization and Society affairs were discussed. A Student

TABLE 2 CHANGES IN MEMBERSHIP

Sept. 30, 1950 to Sept. 30, 1951

| | Membership | | Increases | | | Decreases | | | | Changes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sept. 30, 1951 | Sept. 30, 1950 | Transferred to | Elected | Rein-stated | Transferred from | Re-signed | Dropped | Died | Increases | Decreases | Net changes |
| Honorary Members | 53 | 52 | 4 | 1 | | | | | 4 | 5 | 4 | + 1 |
| Fellows | 360 | 325 | 49 | | | 3 | | | 11 | 49 | 14 | + 35 |
| Members | 13108 | 12702 | 354 | 446 | 106 | 49 | 142 | 165 | 144 | 906 | 500 | + 406 |
| Associates | 376 | 383 | | 19 | 4 | 3 | 7 | 9 | 11 | 23 | 30 | − 7 |
| Junior (20) | 3185 | 3862 | 210 | 71 | 48 | 644 | 92 | 264 | 6 | 329 | 1006 | − 677 |
| Junior (15) | 2188 | 3836 | 280 | 118 | 27 | 1672 | 90 | 307 | 4 | 425 | 2073 | −1648 |
| Junior (10) | 17398 | 13181 | 1780 | 3657 | 28 | 306 | 188 | 743 | 11 | 5465 | 1248 | +4217 |
| Totals | 36668 | 34341 | 2677 | 4312 | 213 | 2677 | 519 | 1488 | 191 | 7202 | 4875 | +2327 |

Branch was established at the South Dakota School of Mines and Technology, Rapid City, S. D., bringing the number of Branches in Region VI to 23. Northern Tier and Southern Tier Regional Student Conferences afforded opportunity for participation of many capable students.

Seven Sections, one Sub-Section, and 14 Student Branches comprise Region VII. The Regional Administrative Committee met at Salt Lake City, Utah. The Oregon Section staged its First Annual ASME Seminar. Two Student Branch Conferences were held, one at the University of Southern California and the other at Oregon State College.

Activities of the six Sections of Region VIII are reported as being vigorous. To the two original Sub-Sections at Sabine and Albuquerque has been added one at Wichita, Kan., and the formation of others is imminent. The Regional Administrative Committee meeting was held at Kansas City, Mo., in conjunction with the second of a series of three Regional Meetings and the Northern Tier Student Conference. Two other Student Conferences were held at Baton Rouge, La. (Southern Tier), and Laramie, Wyoming (Rocky Mountain Tier), with 20 Student Branches participating.

The Regional Delegates Conference was held at Toronto, Canada, in connection with the 1951 Semi-Annual Meeting. Recommendations of the Conference have been referred to the appropriate committees by the Council for report.

#### EJC ENGINEERING MANPOWER COMMISSION ACTIVE

In services to the engineering profession in the United States our representatives on several joint bodies continued to exert leadership and report progress. The Engineering Manpower Commission of Engineers Joint Council, under the chairmanship of Carey H. Brown, Member ASME, set up a secretariat with T. A. Marshall, Jr., in charge. Numerous meetings were held. The essential facts of the critical shortage of engineering manpower were brought to the attention of the nation, and particularly to more than 20,000 high schools, by means of appropriate bulletins and newsletters.[1] A manpower convocation, the purpose of which was to arouse industrialists and high-school and college teachers to doing something about the shortage of engineers, such as organizing local manpower groups, utilizing engineering services to the fullest extent of the capacities of the engineers already employed, and publicizing the opportunities in engineering as a career for qualified young men, was held at Pittsburgh on September 28. Indications give promise of worth-while results.

#### ENGINEERS JOINT COUNCIL REPORTS RESULTS

Engineers Joint Council met regularly. At the request of the government it convened a panel of engineers to advise on procedures for national salary stabilization. It issued a revised report, "Principles of a Sound National Water Policy," and a critique of the report on this subject made public by the President's Temporary Water Resources Commission. Both documents were sent to members of the Congress.

The Committee on International Relations has given much time to the Pan-American Union of Engineering Societies (UPADI). Technical assistance to foreign countries, in cooperation with ECA, was given by the CIR Commission on Technical Assistance. Ralph L. Goetzenberger succeeded R. M. Gates as EJC representative on the U. S. National Commission for UNESCO.

Throughout the year local sections of EJC societies discussed the report of the Exploratory Group of engineering-society representatives on a plan for unity in the engineering profession.

Efforts are being made to assure appointment of engineers on the National Science Foundation Board to fill posts made vacant by the resignation of Charles E. Wilson and the death of Edward L. Moreland.

The National Engineers Committee succeeded in obtaining proper recognition of professional engineers in the Army Reorganization Act.

#### ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

Our representatives on Engineers' Council for Professional Development continued to serve that organization and its program. The Guidance Committee was reorganized and developed a plan for nationwide activities. Progress toward implementation on a nationwide scale of the so-called Monteith report on the development of young engineers during the first five years after graduation has been slow, but the program outlined in the report has attracted wide and favorable attention and a portion of the needed funds has been assured.

#### PAN-AMERICAN CO-OPERATION

On the international front we are happy to report the successful conference at Havana, Cuba, of representatives of engineering groups of South, Central, and North America, looking toward an organization known as the Pan-American Union of Engineering Societies (UPADI). EJC will participate in this organization and a constitution and by-laws are in process of formation for discussion and probable approval at a meeting to be held at New Orleans, La., in the fall of 1952. James M. Todd, past-president of ASME, was appointed a member of the board of directors, and S. L. Tyler a member of the Committee on Constitution and By-Laws of UPADI.

#### NATIONAL MANAGEMENT COUNCIL

The National Management Council organized the first of a series of executive management seminars at the request of ECA as a part of the technical assistance program, in addition to handling ECA-sponsored management teams from Europe. Many ASME members attended the Ninth International Management Congress. Dr. L. M. Gilbreth was elected honor-

ary counselor of CIOS (International Committee for Scientific Management) and H. M. Maynard, deputy president of CIOS.

###### HEAT TRANSFER CONFERENCE IN LONDON

An international conference on heat transfer was held in London, Sept. 11–13, 1951, with The Institution of Mechanical Engineers as host with the co-operation of the ASME. Thirty-two of the 92 papers discussed were prepared by American authors. ASME published preprints of the American papers. As a feature of the program A. P. Colburn, Member ASME, presented the James Clayton Lecture of The Institution of Mechanical Engineers.

###### INTERNATIONAL STANDARDIZATION

The ASME Board on Codes and Standards reports that international standardization projects are still its most pressing problems. With the decision to hold the 1952 Annual Meeting of the International Organization for Standardization in New York the Board realizes that it will be called upon to furnish service for a number of committees in which it participates actively, and hence has requested funds for use in international work.

Requests for co-operation continue to be received from abroad, in many instances reinforced by requests from the U. S. military departments who are trying to effect interchangeability of war materials within the Atlantic Pact countries. On invitation from the British, a delegation attended a conference in London in April which resulted in agreement on unified sizes for bolt and nut hexagons—a next step in the unification of screw threads.

The ISO screw-thread project remains active. ASME has been asked to participate actively in projects concerning thread tolerances and limits and fits.

###### ENGINEERING SOCIETIES OF WESTERN EUROPE AND U.S.A.

The Secretary of the Society attended the conference of representatives of the engineering societies of Western Europe and the United States at The Hague, The Netherlands, September 16–20. Nine countries were represented. An abridged name, EUSEC, was adopted, and several actions to strengthen the organization were taken. Four new bodies were admitted, including AIME and AIChE. Working relations between EUSEC, the Conference of Engineering Institutions of the British Commonwealth, and UPADI were adopted. Means were set up to provide for more frequent interchange of information between the participating societies.

###### ENGINEERING SOCIETIES LIBRARY

The Engineering Societies Library in New York, of which the ASME Library is a part, served 18,104 visitors and received 16,783 mail requests for service. The Engineering Societies Monographs series was enriched by the addition of a text entitled "Hydraulic Transients," by George R. Rich, Member ASME. The Library Agreement between the Founder Societies and the United Engineering Trustees, Inc., was revised for the first time in 35 years.

We regret to report the death of Harrison W. Craver, consulting librarian of the Library, who served as its director for 29 years and was one of the pioneer technology librarians of his day.

###### ASME WOMAN'S AUXILIARY

The Woman's Auxiliary reports a membership of 989 in 12 sections. It has been active locally and in providing entertainment for the women who attend national meetings. Its educational funds are active. The Calvin W. Rice Memorial Scholarship was awarded to a French student who is doing work at Purdue University.

###### ASME FINANCIALLY SOUND

Financial statements summarized in this report show that in spite of rising prices and costs and the largest and most varied program of activities ever undertaken by the Society, ASME lived within its income and added $30,997.76 from operating income to its surplus.

An increase in dues was voted by the members to go into effect on Oct. 1, 1951, this being the first increase in dues since 1922. About one half of the Society members will now pay dues in the amount of $5 per year more than they formerly paid. The additional income which the Society will receive will be used to maintain and, if possible, to improve services to the members. A special committee has been established to recommend the manner in which this may be accomplished.

###### POLICY FOR INVESTMENT OF SOCIETY FUNDS

On recommendation of the Finance Committee, the Council, at the Semi-Annual Meeting, approved the following policy for investment of Society Funds:

1 The indemnification against suit of members of the Council, members of Committees, and officers of the Society in pursuit of their duties by proper amendment to the Constitution, By-Laws, and Rules.

2 The money and Government bonds composing the three funds: (*a*) Custodian Fund, (*b*) Development Fund, (*c*) Retirement Fund, be continued in cash and Government bonds.

3 Sufficient general funds of the Society to be kept in the form of cash to provide working capital.

4 Of the remaining general funds of the Society, approximately $450,000 to be retained in U. S. Savings Bonds as a reserve available in dollars for use under adverse emergency conditions as directed by the Council.

5 The amount of approximately $400,000 being the balance of Society and Trust Funds to be invested in a diversified portfolio of Short Term Bonds, Long Term Bonds, and Preferred Stocks and Equities, all as recommended by investment counsel from time to time, and as approved by the Finance Committee and the Executive Committee of the Council.

The diversification to be carried out over a period of time to minimize the hazards of loss or depreciated values so that the proper diversification shall be accomplished to compensate in part for the changing value of the dollar.

6 In accordance with the recommendations of Scudder, Stevens and Clark, it is not intended to increase at this time the percentage of equities or common stocks held by the Society. Also, relative to this recommendation of Scudder, Stevens and Clark it should be noted that the Executive Committee has as of this time placed certain restrictions on the total amount of Government bonds to be sold of $210,000 and the proceeds reinvested in other forms of securities. It is understood, however, that this amount will be changed from time to time by the Executive Committee.

###### COUNCIL MEETINGS

The Council met twice, at New York, November, 1950, and at Toronto, Canada, June, 1951. Vice-Presidents also held meetings at the 1950 Annual Meeting and the 1951 Semi-Annual Meeting in New York and Toronto, respectively. The Executive Committee of the Council held six meetings.

###### PRESIDENT'S VISITS

The President, at the close of his administrative year, will have attended 60 Section meetings and 55 Student Branch meetings. Thirteen of these were joint meetings of Student Branches or Sections or Student Branches and Sections. In addition, he attended the Annual Meeting in New York, Spring Meeting in Atlanta, Ga., Semi-Annual Meeting in Toronto, Fall Meeting in

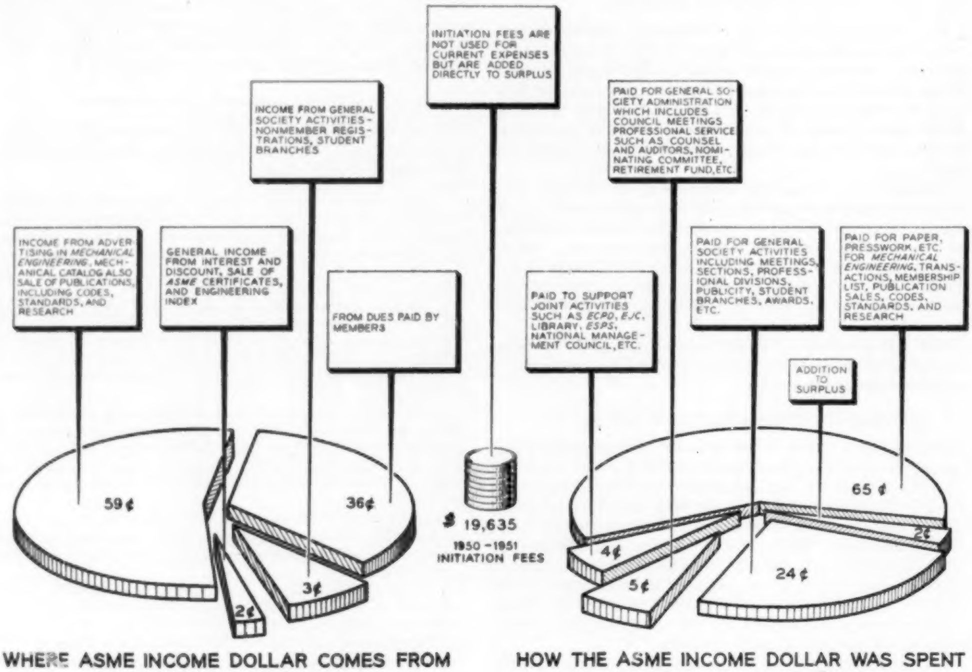
Minneapolis, Regional Administrative Committees IV and VIII in Atlanta and Kansas City, respectively, and Student Conference, Kansas City; also, the Pittsburgh Engineering Conference, Oil and Gas Power Conference, Dallas, and the Petroleum Conference, Tulsa.

DEATHS

Among those who died during the year were Past-Presidents William L. Abbott (also an Honorary Member), on Feb. 20, 1951, and Edwin S. Carman, Mar. 20, 1951; Honorary Members, Willis H. Carrier, Oct. 7, 1950, Charles E. Ferris, May 19, 1951, and D. C. Jackson, July 1, 1951; R. C. H. Heck (Fellow), Sept. 22, 1951; E. L. Moreland, June 17, 1951, and Boris A. Bakhmeteff, July 21, 1951.

SECRETARY'S OFFICE

A. W. Schrage, production manager of MECHANICAL ENGINEERING, who had been a member of the staff for 32 years died on Nov. 23, 1950. Frederick Lask, advertising manager, associated with the Society for 37 years, retired December, 1950. Members of the staff who completed thirty years of service were C. E. Davies, Marie J. Mullan, Leslie Scanlan, and Benjamin Theroux. Mary Fischer and Jeannette M. Meyer completed twenty-five years of service.




WHERE ASME INCOME DOLLAR COMES FROM
TOTAL INCOME 1950-1951 – $1,299,172.90

HOW THE ASME INCOME DOLLAR WAS SPENT
TOTAL EXPENSES 1950-1951 – $1,268,175.14 *
* ADDITION TO SURPLUS $30,997.76

# ASME Finances

## FINANCES[1]

The income of the Society for the year exceeded $1,299,000, the largest income in the history of the Society. The policy of the Council was to use the income of the Society for service to the members. A net income over expense of $30,997.76 is reported. This amount, plus initiation and transfer fees amounting to $19,635, makes a total addition to surplus for the year of $50,632.76.

The Balance Sheet of September 30, 1951, shows, on that date, that the Society owed:

| | |
|---|---|
| (1) Current bills and federal tax withheld from employees | $ 9,079.78 |
| (2) Obligations for printing and distributing the 1950 Mechanical Catalog and other bills which have not been submitted | 38,751.86 |
| (3) Unexpended appropriations for future services | 72,115.15 |
| (4) Special research and other committees which have collected funds for special purposes to be expended as needed | 147,368.56 |
| (5) Future services to members who have prepaid dues | 126,591.39 |
| | $ 393,906.74 |

To meet these debts the Society had:

| | |
|---|---|
| (1) Cash in the bank | 140,269.43 |
| (2) Accounts receivable | 132,404.24 |
| (3) Inventories of publications and supplies conservatively valued at | 106,161.83 |
| (4) Securities (at the lower of cost or approximate quoted market values) | 710,220.81 |
| | $1,089,056.31 |

| | |
|---|---|
| The difference between the value held by the Society of $1,089,056.31 and debts of $393,906.74 is the net worth of the Society on September 30, 1951, $695,149.57, of which $500,000.00 has been set aside as a general reserve against contingencies, leaving a balance of | $ 195,149.57 |

The Society had other liabilties:

| | | |
|---|---|---|
| (1) Development Fund of | | $ 24,407.68 |
| Against which it had | | |
| (a) Cash | $ 320.18 | |
| (b) Securities (at the lower of cost or approximate quoted market values) | 19,587.50 | |
| (c) Notes receivable | 4,500.00 | |
| | $ 24,407.68 | |
| (2) Employees' Retirement Fund of | | $ 104,261.29 |
| Against which it had | | |
| (a) Cash | $ 14,616.84 | |
| (b) Securities (at the lower of cost or approximate quoted market values) | 89,644.45 | |
| | $104,261.29 | |
| (3) Trust Funds amounting to | | $ 172,446.01 |
| Against which the Society had the following assets: | | |
| (a) Cash | $ 29,405.08 | |
| (b) Securities (at the lower of cost or approximate quoted market values) | $142,390.93 | |
| (c) Toltz notes receivable | 650.00 | |
| | $172,446.01 | |
| (4) Property Fund of | | $ 570,207.20 |
| With the following assets to support it: | | |
| (a) Quarter interest in building | $498,448.48 | |
| (b) Office furniture and fixtures (depreciated value) | 71,757.72 | |
| (c) Engineering Index, Inc.—Title and good will | 1.00 | |
| | $570,207.20 | |

[1] The certified report of the auditors, Price, Waterhouse & Co., is on file in the Society office and available for inspection by the members.

Table 3 shows the income and expense for the major groupings of Society activities. Table 4 shows the activities which produce an income and those which result in a net expense.

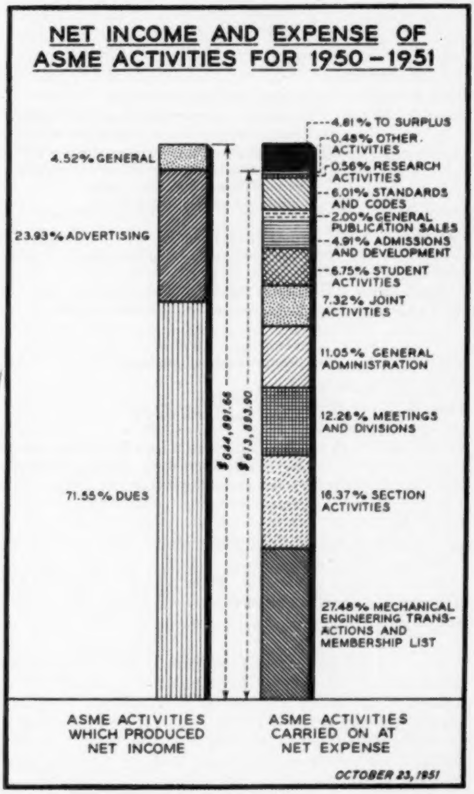


TABLE 3 INCOME AND EXPENSE FOR MAJOR GROUPS OF SOCIETY ACTIVITIES

| | Expense | Income | Net | Expense per member | Income per member | Net expense per member |
|---|---|---|---|---|---|---|
| Dues | ... | $ 461,476.60 | $461,476.60 | .. | $12.59 | ... |
| General Income (interest, discount, emblem sales, Engineering Index Inc.) | ... | 29,124.12 | 29,124.12 | ... | 0.79 | ... |
| Publications, Standards, Codes, and Research | $ 844,305.12 | 765,423.38 | 78,881.74 | $23.02 | 20.87 | $ 2.15 |
| General Society Activities (meetings, sections, student branches, admissions, etc.) | 305,411.98 | 43,148.80 | 262,263.18 | 8.33 | 1.18 | 7.15 |
| General Society Administration (council, auditors, counsel, retirement fund) | 71,254.62 | ... | 71,254.62 | 1.94 | ... | 1.94 |
| Joint Activities (Library, ECPD, EJC, etc.) | 47,203.42 | ... | 47,203.42 | 1.29 | ... | 1.29 |
| Additions to surplus from operating income | 30,997.76 | ... | ... | 0.85 | ... | 0.85 |
| *Total | $1,299,172.90 | $1,299,172.90 | ... | $35.43 | $35.43 | $13.38 |
| Addition to surplus from initiation fees | | 19,635.00 | | | | |
| Total addition to surplus | | 50,632.76 | | | | |

TABLE 4 INCOME AND EXPENSE OF ASME ACTIVITIES 1950–1951

| | | |
|---|---|---|
| *Activities Which Produce a Net Income* | | |
| MECHANICAL ENGINEERING and Mechanical Catalog advertising income | $533,836.17 | |
| Less production costs, wages, and indirect | 379,545.23 | |
| | | $154,290.94 |
| Engineering Index, Inc. | | 3,106.70 |
| Miscellaneous Sales | | 5,724.19 |
| Interest and Discount | | 20,293.23 |
| Membership Dues | | 461,476.60 |
| Total | | $644,891.66 |
| *Activities Carried on at a Net Cost* | | |
| MECHANICAL ENGINEERING Text (production, wages, and indirect) | | $127,811.65 |
| Transactions (production, wages, and indirect) | | 38,864.42 |
| Membership List (production, wages, and indirect) | | 10,519.94 |
| Organization Charts (production and indirect) | | 759.77 |
| General Publications Sales income | $ 95,439.27 | |
| Stock cost, wages, and indirect | 108,324.86 | 12,885.59 |
| Standards and Codes income | $133,798.93 | |
| Stock cost, wages, and indirect | 172,545.37 | 38,746.44 |
| Research Income | $ 2,349.01 | |
| Stock cost, wages, and indirect | 5,933.88 | 3,584.87 |
| Student Dues | $ 40,362.00 | |
| Student expense (production, wages, and indirect) | 83,862.64 | 43,500.64 |
| Meetings Income | $ 2,786.80 | |
| Costs, wages, and indirect | 61,038.07 | 58,251.27 |
| Sections (appropriations, travel, wages, and indirect) | | 105,590.51 |
| Divisions (appropriations, wages, and indirect) | | 20,827.19 |
| Admissions and Development (wages and indirect) | | 31,694.09 |
| Awards (costs, wages, and indirect) | | 2,399.48 |
| Joint Activities | | 47,203.42 |
| General Administration | | 71,254.62 |
| Total | | $613,893.90 |
| Net Income | | $ 30,997.76 |

# ASME MEETS AT ATLANTIC CITY

## *Seventy-Second Annual Meeting Offers Most Extensive Program of Technical Sessions Ever Attempted*

THE Seventy-Second Annual Meeting of The American Society of Mechanical Engineers got under way at the Chalfonte-Haddon Hall, Atlantic City, N. J., with sessions of the Council on Sunday, Nov. 24, 1951, and continued through Friday of that week. A registration of 4600 was recorded. The 120-page program, which listed also the sessions of the American Rocket Society, affiliated with ASME, included 337 speakers, 222 papers and addresses, 92 technical sessions, 4 panels, numerous luncheons and dinners, and committee meetings, the events scheduled by the Woman's Auxiliary to ASME, college reunions, and social gatherings.

High lights of the more general sessions included the address by J. Calvin Brown, president ASME, the Roy V. Wright lecture delivered by W. C. Mullendore, president of the Southern California Edison Company, the presentation of awards and honors at an Honors Luncheon and the Annual Dinner, past-president W. L. Batt's speech at the Dinner, and the Members and Students Luncheon.

Technical sessions covered a variety of subjects and areas of engineering interest from the more general ones dealing with education and management to the highly specialized discussions which required close attention and a broad background of scientific knowledge and experience to comprehend. A high percentage of these technical papers were available in preprint form and a list of preprints, arranged according to field of interest, will be found on pages 76–78 of this issue. Digests of these papers have appeared or will appear in MECHANICAL ENGINEERING and the complete text of every paper in preprint form may be purchased from the Society. Many of these papers will appear, or have appeared, in full in this magazine and in ASME Transactions and the *Journal of Applied Mechanics*.

To include in this brief report of the 1951 Annual Meeting even mention of every paper or digest of the discussion provoked would be a task beyond its scope and purpose. In what follows, attention is directed chiefly to those portions of the program that are not subsequently covered by publication of the technical papers and the events of general interest. Some of this material will be found in the ASME News Section. Other material relating to the meeting and appearing in this issue includes the 1951 Report of the ASME Council and statement on finances, pages 42–48, the biographies of the recipients of honors and awards, pages 69–72, and reports of the Womans' Auxiliary functions and those of the Junior Committee, pages 88 and 95, respectively.

#### JOINT CONFERENCE OF THE COUNCIL

At an informal meeting of the Council, chairmen and members of Boards, Divisions, and Committees, and members of the Society, a Progress Report of the Special Committee on Society Policy was presented and discussed on Sunday evening, November 25. Mr. Brown presided and E. G. Bailey, chairman of the Special Committee, summarized the report. Other members of the committee are Harold V. Coes, A. R. Mumford, F. M. Gunby, and A. L. Penniman, Jr.

The committee recommended preparation of a Society Manual on Society Policies, and to that end Mr. Mumford had prepared a memorandum based on excerpts of the minutes of the Council and the Executive Committee.

Mr. Bailey proposed a list of subjects for general discussion: Membership dues and privileges; Society meetings and divisional conferences; standards for technical papers; publications; professional divisions; finances; research; the Development Fund; and relationships with joint activities. Discussion of these topics continued throughout a two-hour session with emphasis on meetings, divisions, finances, and the work of the Engineering Manpower Commission of EJC and of the Guidance Committee of ECPD.

### SESSIONS OF THE ASME COUNCIL

A meeting of the Council of The American Society of Mechanical Engineers was held at Haddon Hall, Atlantic City, N. J., on Sunday afternoon, Nov. 25, 1951, in connection with the 1951 Annual Meeting of the Society, and was continued on Monday morning and afternoon, Nov. 26, 1951. J. Calvin Brown, president, presided. At the opening of the Council Meeting, the Secretary read a letter from William M. Sheehan, director at large, expressing his regret that business in South Africa prevented his attendance and conveying his greetings and best wishes to all members of the Council.

The following actions of the Council are of general interest.

#### REPORTS

The annual report of the Council (see pages 42–48 of this issue) was presented and approved for submission to the Business Meeting. Reports of Boards, Committees, and joint activities were received. Copies of these reports are available and may be obtained from the Secretary. The annual report of the Woman's Auxiliary to ASME was also received and has been summarized in the report of the Council.

#### CONSTITUTION AND BY-LAWS

Certain revisions to the By-Laws were presented for second reading and were approved to go into effect at the Business Meeting. Two constitutional amendments favorably passed by letter ballot of the members, one relating to indemnification of officers and the other providing for assistant secretaries and assistant treasurers, made it desirable to include these officers in Art. B6, Par. 1, relating to the Executive Committee; and in Art. B8, Par. 4, relating to the Council. In Art. B8, Par. 6 and Par. 9 (new), certain duties of the assistant treasurer and assistant secretary, respectively, are stated. Present Par. 9 of Article B8 is renumbered Par. 10.

Article B6, Par. 2 is amended to require each vice-president to "reside or have his principal place of business in the Region which he represents."

Article B6A, Par. 11, is amended to read as follows:

"The Finance Committee, under the direction of the Council, shall have supervision of the financial affairs of the Society, including the books of account. The committee shall consist of one (1) past-president, if possible, or past vice-president, or former member of the Council, the treasurer, the assistant treasurer, one (1) director at large, and five (5) members at

*J. Calvin Brown*

*Retiring President of The American Society of Mechanical Engineers for 1951*

large. The past-president or past-vice-president or former member of the Council shall serve two (2) years, the director at large shall be appointed annually, and the five (5) members at large shall serve five (5) years, the term of one (1) member expiring at the business meeting during the Annual Meeting of the Society."

Article B8, Par. 5, is amended by deletion of the second sentence, leaving the paragraph to read: "The treasurer shall be the legal custodian of all funds of the Society."

In Art. B14, Pars. 7, 8, and 9 are deleted and a new Par. 7 reads: "The Finance Committee, under the direction of the Council, shall make recommendations on investment of all funds." Former Par. 10 becomes Par. 8.

A new By-Law, Art. B6A, Par. 18C, received for first reading, sets up the Junior Committee as a standing committee of the Society, under the direction of the Board on Education and Professional Status, and defines its objective as "the development and implementation of policies and procedures directed toward the professional development of young engineers and the encouragement of junior members to participate in the affairs of the Society," and provides for the personnel of the committee and terms of service. This By-Law will be presented for second reading at the 1952 Semi-Annual Meeting next June.

#### BOARD ON TECHNOLOGY

Col. Crosby Field, member of the Board on Technology, presented the recommendation of the Board "that the Council appoint a special research-review committee to serve from six months to a year and to consist of Messrs. N. E. Funk, chairman, E. G. Bailey, H. Weisberg, H. L. Solberg, R. C. Allen, S. N. Fiala, and the representatives of the Council on the Board on Technology, to carry out the following functions: (1) Review the functions and procedures of the Standing Research Committee; (2) suggest competent personnel for the Standing Research Committee; (3) put into effect the recommendations of the Special Committee on Research Policy; and (4) assist the Secretary in selecting adequate staff to carry on the work." The Council voted to appoint this Special Committee.

*R. J. S. Pigott*

*President of The American Society of Mechanical Engineers for 1952*

UNITY OF THE ENGINEERING PROFESSION

Edgar J. Kates, who represents ASME on the Exploratory Group which was established by Engineers Joint Council to study and report on a unity organization for engineers, said that the four suggested plans of organization which he discussed with the Council a year ago had been under consideration by sections of the societies represented in the Group and expressions of opinions had been received. As a result a draft report had been prepared which would be submitted at a meeting of the Group to be held on Dec. 15, 1951. Mr. Kates forecast that this report would suggest a first step in the formation of a unity organization which involves admitting to EJC membership a number of national engineering societies. It is hoped that the enlarged EJC will then be able to study further details of the unity problem.

ENGINEERS JOINT COUNCIL

A report on the year's activities of Engineers Joint Council was presented by James M. Todd, who has just completed his term as president of EJC. He mentioned briefly such activities as the work of the Exploratory Group; the report of the National Water Policy Committee, which has been distributed to members of the Congress; the Engineering Manpower Commission's status and progress; the report to the Salary Stabilization Board; EJC's relations with the National Science Foundation; the varied interests and accomplishments of the Committee on International Relations, with particular reference to the Pan-American Union of Engineering Societies (UPADI); the aid given to Economic Cooperation Administration and its Technical Assistance Division; the appointment of Ralph L. Goetzenberger to succeed R. M. Gates as EJC's representative on the United States National Commission for UNESCO; and to the help and advice given to EJC by Hartley Barclay of the *New York Times*.

CODES AND STANDARDS

B. P. Graves, chairman of the Board on Codes and Standards, read from the annual report of the Council the portions of it

# New Members of the 1952 ASME Council

## Regional Vice-Presidents

E. H. HANHART

W. F. THOMPSON

S. H. GRAF

E. S. THEISS

## Directors at Large

A. C. PASINI

P. B. EATON

that summarize the work of the Board. He also reported that a new scale of prices of standards has been devised, in an effort to eliminate the deficit incurred in the operation of this field of Society service.

The Council voted to extend for one year the terms of office of H. B. Oatley and A. G. Christie, chairmen of the Boiler Code and Power Test Code committees, respectively.

DEVELOPMENT FUND

James D. Cunningham reported progress being made in the task he has undertaken with R. H. Bacon, to raise by subscription a Development Fund. A brochure is to be mailed to members and industrial concerns. Industry committees have been formed, and early completion of the project is confidently expected. The Council voted to confirm former authorization of the project.

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

Guy R. Cowing gave a brief summary of the 1951 annual report of the Engineers' Council for Professional Development, reviewing the activities of its principal committees with emphasis on the Monteith report on a program of training for young engineers during their first five years after graduation; the reorganization and program of the Guidance Committee; the progress made in the accrediting of engineering curricula; and special reports on the accreditation of graduate curricula and on adequacy and standards of engineering education.

NATIONAL MANAGEMENT COUNCIL

A report on the National Management Council, of which ASME is a member, was presented by Harold V. Coes.

STUDENT BRANCHES

Approval was voted of the establishment of ASME Student Branches at Ohio University and the University of Dayton.

FINANCES

Harry E. Whitaker, chairman of the Finance Committee, presented the financial statement as of Oct. 31, 1951.

C. E. DAVIES, ASME SECRETARY; J. CALVIN BROWN, RETIRING PRESIDENT OF THE ASME (1951), AND REGINALD J. S. PIGOTT, PRESIDENT FOR 1952, ARE SHOWN FROM LEFT TO RIGHT

#### CERTIFICATES OF AWARD

A certificate of award for the services of F. J. Daasch, in connection with the 1951 Petroleum Mechanical Engineering Conference, was approved.

Certificates of Award to retiring chairmen of Sections and retiring chairmen of Professional Divisions, Executive Committees were reported.

#### BOARD ON PUBLIC AFFAIRS

Reporting for the Board on Public Affairs, D. Robert Yarnall reviewed studies made by the Board of the request of the Mexico Group to be accorded Section status. After full debate the Council voted to grant Section status within Region VIII to the Mexico Group and set down certain arrangements under which dues payment and other financial matters are to be handled.

The Board recommended that the Council establish a policy of wider participation than usual in the 1952 Fall Meeting which is to be held in Chicago in connection with the Centennial of the American Society of Civil Engineers. It recommended that official invitations be issued to certain engineers outside the United States and that the Board on Technology and the Professional Divisions, in planning programs for the meeting, bear in mind the international character of the occasion.

The Council approved these recommendations.

#### BOARD ON MEMBERSHIP

D. W. R. Morgan, on behalf of the Board on Membership, recommended the adoption of standard grades of membership suggested by ECPD and already adopted by AIEE. The Council directed the Constitution and By-Laws Committee to draw up the changes necessary for consideration of this recommendation of the Board and to present them at the 1952 Semi-Annual Meeting.

#### SECTIONS

On recommendation of vice-president of Region VII, Professor Graf, and with the approval of the Inland Empire Section, the Subsection at Richmond, Wash., was advanced to Section status and will be known as the Columbia Basin Section.

#### STUDENT MEMBERS

The Council voted to change the forms used by candidates for student membership to include, in addition to certification of registration in an approved curriculum, endorsement by the Honorary Chairman of the Branch in which application for student membership is being made.

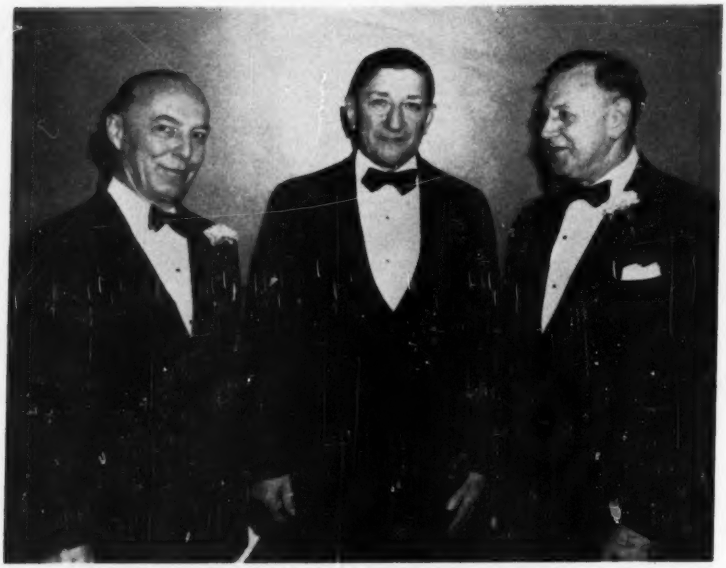
### 1952 COUNCIL MEETS

An organization meeting of the 1952 ASME Council was held on Monday evening, Nov. 26, 1951, in connection with the 1951 Annual Meeting. J. Calvin Brown called the meeting to order, introduced the newly elected members, and presented the President's gavel to R. J. S. Pigott, who then took the chair.

Certificates of award were presented to the retiring members of the Council and a special emblem was given to J. Calvin Brown, president, 1951.

#### APPOINTMENTS

The Council voted to reappoint C. E. Davies, secretary, and Joseph L. Kopf, treasurer. Edgar J. Kates was reappointed assistant treasurer and Mr. Kopf, treasurer of the Development Fund. The Executive Committee of the Council for 1952 will



J. CALVIN BROWN, RETIRING PRESIDENT OF THE ASME; ERNEST HARTFORD, EXECUTIVE ASSISTANT SECRETARY OF THE SOCIETY, AND REGINALD J. S. PIGOTT, 1952 ASME PRESIDENT

(Mr. Hartford, who has been with the Society since 1911, maintained his perfect record by making the 1951 gathering his 40th annual meeting in a row without a miss.)

consist of Willis F. Thompson, Henry R. Kessler, A. C. Pasini, and Ralph A. Sherman, in addition to Mr. Pigott who will serve as chairman.

Appointments of members of the Council to Boards and Committees were made as follows: Board on Codes and Standards, B. P. Graves; Board on Education and Professional Status, Paul B. Eaton; Board on Honors, L. J. Cucullu; Board on Membership, A. C. Pasini; Board on Public Affairs, J. A. Keeth (H. E. Martin, alternate); Board on Technology, Ralph A. Sherman; Finance Committee, H. E. Martin; Organization Committee, T. E. Purcell.

#### SPECIAL COMMITTEES

The Council voted to discontinue the Public Relations Committee, and to continue the following special committees: Applied Mechanics Reviews Managing Committee, Freeman Award Committee, Committees on Revision of Honors, Manual of Consulting Practice, and Metals Engineering Handbook, Nuclear Energy Applications Committee, Pension Committee, and Committee on Society Policy. The status of the Junior Committee is to be changed from that of a special to that of a standing committee.

#### FUNCTIONS OF BOARDS

Statements of the delegation of authority to the Board on Technology and the Board on Codes and Standards and of their procedures were approved by the Council.

#### ENGINEERING INDEX

Approval was voted of an agreement extending the agreement of Sept. 28, 1934, between the Society and Engineering Index, Inc.

## 1951 ANNUAL BUSINESS MEETING OF THE ASME

The 1951 Annual Business Meeting of The American Society of Mechanical Engineers was called to order by J. Calvin Brown, president, at Haddon Hall, Atlantic City, N. J., on Monday, Nov. 26, 1951.

Annual reports of the Council, Boards, and Committees were presented by the Secretary, and H. E. Whitaker presented the report of the Finance Committee for the fiscal year ending Sept. 30, 1951. (The substance of these reports will be found on pages 42–48 of this issue.) For the record the Secretary listed property held by the Society and reported the number of members elected during the year and a list of members deceased. By motion the reports and the actions of the Council and officers for the year 1950–1951 were approved.

The Secretary read the report of the tellers of election of officers, as follows: A. C. Pasini and Paul B. Eaton, directors at large; Willis F. Thompson, E. H. Hanhart, Ernest S. Theiss, and S. H. Graf, vice-presidents; and R. J. S. Pigott, president.

The report of the tellers on Constitution amendments was read by the Secretary, and the amendments were declared to be in effect. These amendments relate to indemnification of officers of the Society and the appointment of assistant secretaries and treasurers.

## DINNERS AND LUNCHEONS

#### THE PRESIDENTS' LUNCHEON

The Presidents' Luncheon was held at the Chalfonte Hotel, Atlantic City, N. J., on Monday, Nov. 26, 1951. James D.

SENATOR RALPH E. FLANDERS, WILLIAM L. BATT, AND SCOTT TURNER AT THE 1951 ASME ANNUAL MEETING

(*Left to right*, Scott Turner, chairman of the Hoover Medal Board of Award; Senator Ralph E. Flanders of Vermont; William L. Batt, Minister in Charge of the Economic Cooperation Administration to the United Kingdom; Mr. Turner is shown presenting the Hoover Medal for 1951 to Mr. Batt in recognition of his "leadership in engineering, management, and public responsibility, and his many distinguished services to his community and the nation.")

Cunningham, past-president of the Society, presided and introduced the persons seated at the head table. In responding to the introduction, Mrs. F. W. Miller, president of the Woman's Auxiliary to ASME, said that the Auxiliary now has 14 sections and about 1000 members. She spoke briefly on behalf of the Education Fund from which loans are made to students, and the Calvin W. Rice Memorial Scholarship which is awarded to a foreign student for graduate studies in the United States.

R. J. S. Pigott, president-elect, extended his greetings to the members and expressed his appreciation of the honor done him by his election.

The principal address was delivered by J. Calvin Brown, president ASME, who took for his topic, "Benjamin Franklin, Statesman, Diplomat, Inventor, Author." He reviewed a number of Franklin's inventions and investigations that had exerted wide influence on the world, such as the Franklin stove, the electrostatic machine, and pronouncements on the positive and negative characteristics of "electric fluid," studies of heat transfer, meteorology, lightning, bulkheads in ships, bifocal spectacles, and the formation of the American Philosophical Society. He made brief mention of the Junto Club which Franklin organized for the discussion of subjects in the fields of economics and natural philosophy. Mr. Brown spoke feelingly of Franklin's statesmanship and humanitarianism, his contributions to the drafting of the Constitution of the United States, and of his strong religious convictions. In closing, Mr. Brown said that Franklin was loyal to principle and never surrendered to expediency. The nation needs another Franklin, he asserted, and suggested that such a man might "be here today."

### HONORS LUNCHEON

At the Honors Luncheon, held Wednesday noon, November 28, R. J. S. Pigott, president of The American Society of Mechanical Engineers, presided. A certificate of honorary membership in The Institution of Mechanical Engineers (Great Britain) was presented to Ralph E. Flanders, past-president and honorary member, ASME, and U. S. Senator from Vermont. In accepting the certificate, Senator Flanders spoke of his early recollections of the Institution formed during a visit to England in 1914, and of his meeting there with Frank Gilbreth.

### HOOVER MEDAL

Scott Turner, chairman of the Hoover Medal Board of Award, which is composed of representatives of the Founder Societies, explained the significance of the Hoover Medal, founded in 1929, and instituted to commemorate the civic and humanitarian achievements of Herbert Hoover, to whom the first award was made in 1930. He called on Senator Flanders to introduce William L. Batt, recipient of the 1951 award, a ceremony which Senator Flanders carried out in his customary witty and informal manner. Mr. Turner read the citation and presented the medal to Mr. Batt. In his response, Mr. Batt, who is a past-president and honorary member of ASME, and at present head of the Economic Cooperation Administration for Great Britain, and United States member of the North Atlantic Defense Production Board with offices in London, spoke of the significant contributions by science made in recent years by Great Britain. He called attention to the British system of education which places great emphasis on the basic sciences.

E. G. BAILEY RECEIVES THE JOHN FRITZ MEDAL

(R. E. Dougherty, *left*, chairman of the John Fritz Medal Board of Award, presents the Fritz Medal to Ervin G. Bailey, *right*, vice-president of The Babcock & Wilcox Co., New York, N. Y., for "outstanding engineering achievements in the field of combustion, and distinguished service to his fellows in advancing the engineering profession." In the center is James M. Todd, past-president of ASME.)

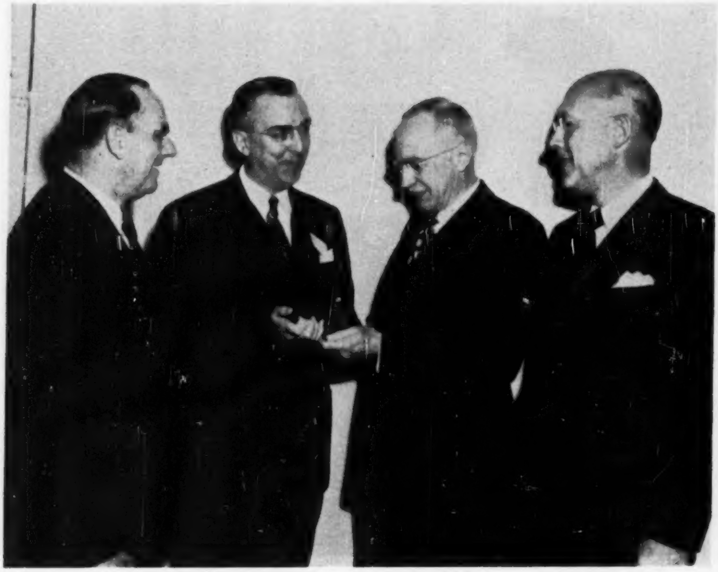
He said that he had often speculated on why engineers talked so much about civic responsibility and had decided that it was the result of something in our system of education. The highest public service, he asserted, begins at home, and reminded the audience that the government cannot do as well as the citizen can do. He was disturbed at the increasing size of the central government, and suggested that a larger participation of the citizen in the affairs of his own community would help in reducing the size of the central government. He concluded by expressing on behalf of himself and his family, his appreciation of the honor done him by the award of the Hoover Medal.

### GANTT MEDAL

J. Keith Louden, vice-chairman of the Gantt Medal Board of Award, introduced the 1951 recipient of the Gantt medal award, Thomas Roy Jones. The Gantt Gold Medal was established in 1929 to memorialize the achievement of that great management engineer, industrial leader, and humanitarian, Henry Laurence Gantt, and may be awarded annually for "distinguished achievement in industrial management as a service to the community," by a board of representatives of The American Society of Mechanical Engineers and the American Management Association. Mr. Louden described the purpose of the medal and the qualifications of those on whom it is bestowed. He recited the achievements of Mr. Jones on the basis of which the award was made and recalled that Mr. Jones had known Mr. Gantt.

In his response, Mr. Jones, who is president of Daystrom, Incorporated, stated that for the past twenty years "the greatest need this country has had is that of statesmanship." In defining what he meant by an industrial statesman he said, "Such a man would have, first and foremost, the basic social and economic requirements of the country firmly grounded in his mind and heart. It would be necessary that he be head of one of the country's largest corporations. He should be imbued with the idea that every act he performed, every move he made within his own company and in the national scene, would be made in the best long-range interests of his country . . . . He would need the support of like-minded executives in the 25 or 50 largest companies in the United States . . . It would be necessary for these leaders to interest themselves in economics, in politics, in education, and to act together unselfishly in all problems of national importance." This was not a visionary's dream, he asserted; we have already had a beginning of such industrial statesmanship. He would not say that it would be wise for the businessman or the industrialist, or any other segment of our society, to be in sole control, but he would say that it was most necessary to the welfare of our country that there be a balance between forces and that the industrial leader must be aggressive in establishing his part of that balance. "The businessman should be a statesman. He has the intelligence. He knows how to get results. He is educated. He has an outlook that is world-wide. There is no member of any other group in American society that can outpoint him on all the requirements of statesmanship. In addition, he has a substantial history of accomplishment."

To emphasize his point, Mr. Jones mentioned many examples of industrial statesmanship and achievements. However, he observed, "we have not been articulate in making them recognized and appreciated by the public. We have not applied the same sales and promotional tactics to selling our most important national product—capitalism— as we have to selling our individual company products." However, a



THOMAS R. JONES RECEIVES THE HENRY LAURENCE GANTT MEDAL

(*Left to right*, William L. Batt, Minister in Charge of the Economic Cooperation Administration to the United Kingdom; J. Keith Louden, vice-chairman of the Gantt Medal Board of Award; Thomas R. Jones, president of Daystrom, Inc., Elizabeth, N. J.; L. A. Appley, president of American Management Associaton. Mr. Louden is pictured presenting the Henry Laurence Gantt Medal to Mr. Jones for "distinguished achievement in industrial management as a service to the community.")

beginning had been made, he said, and cited examples. "Truly great industrial statesmanship can be realized," he concluded, through the vision, the hard work, and the selflessness which is inherent in the type of men who are the industrial leaders of America.

### JOHN FRITZ MEDAL

On behalf of the John Fritz Medal Board of Award, R. E. Dougherty, vice-chairman, introduced James M. Todd, past-president ASME, to present the 1952 recipient of the John Fritz Medal, E. G. Bailey. The John Fritz medal was established in 1902 in memory of John Fritz, one of America's great pioneers in the iron and steel industry. The medal is awarded not more often than once a year for notable scientific or industrial achievement. It is administered by a board of representatives of the Founder Societies. The citation of the 1952 award to Mr. Bailey reads: "For outstanding engineering achievements in the field of combustion and distinguished service to his fellows in advancing the engineering profession."

In accepting the medal Mr. Bailey read a number of quotations from the autobiography of John Fritz. By means of these quotations Mr. Bailey was able to draw a picture of the great engineer for whom the medal is named, including his background and philosophy of life, his experiences at Norristown, Safe Harbor, and Cambria where some of his pioneering work was done in the face of opposition, and his significant contributions made at Bethlehem during the height of his career. Mr. Bailey said that in his opinion John Fritz was one of the best-educated engineers of all time; that he scrupulously obeyed the laws of nature; that he projected his work beyond the practices of his time; and that he "lived economics."

Biographies of the recipients of honors and awards at the luncheon will be found on pages 69–75 of this issue.

### MEMBERS AND STUDENTS LUNCHEON

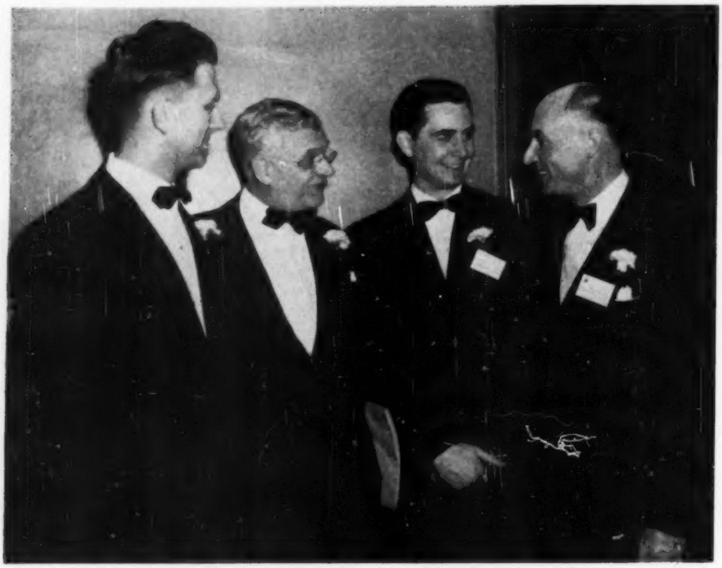
On Thursday noon J. Calvin Brown, president (1951) of The American Society of Mechanical Engineers, presided at the annual Members and Students luncheon. On this occasion student members from colleges of the area are guests of the Old Guard, the Undergraduate Student Award is presented, and the principal speaker is a Junior Member.

Mr. Brown introduced persons seated at the head table and called upon R. J. S. Pigott, president (1952) of ASME for a few remarks.

Mr. Pigott called special attention to the fact that there exists a shortage of engineers because of lowered registration in the engineering colleges and because we are in an era in which engineering services are in increasing demand. He told the undergraduates present not to be afraid of the drafting room when they began their careers because it was an excellent place to acquire experience.

Mr. Brown paid tribute to F. P. Herbert, chairman of the Old Guard, and to that group of older men, and described briefly what they were doing for the benefit of young engineers.

C. E. Davies, secretary ASME, introduced W. A. Burlingame, of Exeter, N. H., who, for the past 18 years has attended ASME meetings and brought with him a young resident of his community. Mr. Burlingame was, said Mr. Davies, a "one-man Old Guard."



WINNERS OF AWARDS

(*Left to right*, Warren M. Rohsenow, assistant professor of mechanical engineering at Massachusetts Institute of Technology, winner of the Gold Medal of Pi Tau Sigma, honorary engineering fraternity, for "outstanding achievement in mechanical engineering within ten years of graduation;" C. E. Davies, secretary of ASME; John D. Stanitz, section head, National Advisory Committee for Aeronautics, Cleveland Airport, recipient of the Junior Award of the society for his paper, "Analysis of the Exhaust Process in Four-Stroke Reciprocating Engines"; Jacob P. Den Hartog, professor of mechanical engineering at M.I.T., who was awarded the Worcester Reed Warner Medal for "outstanding contribution to engineering literature.")

### ADDRESS BY W. M. ROHSENOW

The address at the luncheon was delivered by Warren M. Rohsenow, Junior ASME, assistant professor, Massachusetts Institute of Technology, Cambridge, Mass., and recipient in 1951 of the Pi Tau Sigma Gold Medal Award. Professor Rohsenow spoke on "The Role and Obligations of the Young Engineer." He pointed out that the engineering school is run for the student while industry is not. In the school the student is compelled to direct his energy to educational development but in industry he must exercise his own initiative and direct his own career development. The graduate was faced, during the years immediately following graduation, with a post-college slump which he himself must find the initiative to overcome. The young man's progress upward throughout his career depended on a number of necessary qualities, such as, the scope of his work, his relations with people, his judgment, attention to detail, his ability to delegate authority, and all of these qualities must become broader as he advances.

When the young man is given his first assignment, he said, it is done with the idea of testing how well he can perform it with speed and accuracy. It is necessary to keep the boss informed on the progress of work assigned and to do so without becoming a "yes" man. He must take the initiative, prepare in advance answers to questions likely to be asked, be able to get along with his associates and work with them as a team, develop the ability to present his ideas verbally and in writing, and expand his own knowledge by self-education.

To develop his progress in the profession of mechanical engineering, Professor Rohsenow declared, the young graduate must continue to broaden the scope of his work, he must be informed on and take interest in questions affecting the industry in which he is engaged, and develop his associations with other engineers through such channels as the ASME and other professional organizations, and the writing of papers.

A college degree, said Professor Rohsenow, does not make a professional engineer. Each graduate must carve out for himself a vigorous program of personal improvement. He must do more than he is paid to do, and he will be rewarded by the satisfactions of achievement as well as a better salary. The unsuccessful engineer, he declared, is likely to blame his boss when he himself has done nothing to deserve better treatment, and hence he becomes unhappy.

While encouragement to self-development is many times lacking, the program of the Training Committee of the Engineers' Council for Professional Development had been set up to improve this situation. At the present time, he said, funds for financing this program were being slowly collected and he urged all older men in the audience to see to it that money to support the program would be forthcoming.

The current shortage of engineers, he pointed out, was due partly to the low birth rate of the thirties, to draft policies, and to national indifference. This shortage would continue for several years, and its seriousness could be judged by study of the chart prepared by Dean S. C. Hollister, of Cornell, which was shown. The military requirements of the nation, Professor Rohsenow said, would provide opportunities for technical growth and this fact placed an obligation on engineers.

### UNDERGRADUATE STUDENT AWARD

Following the delivery of Professor Rohsenow's address, Ely

PI TAU SIGMA AND RICHARDS MEMORIAL AWARD

(*Left to right*, Warren M. Rohsenow, assistant professor of mechanical engineering at Massachusetts Institute of Technology, winner of the Gold Medal of Pi Tau Sigma, honorary engineering fraternity, for "outstanding achievement in mechanical engineering within ten years after graduation"; Frank L. Schwartz, president of Pi Tau Sigma, and J. Kenneth Salisbury, division engineer, general engineering and consulting laboratory, General Electric Co., Schenectady, who is being presented with the Richards Memorial Award for "outstanding achievement in mechanical engineering within 20 to 25 years after graduation.")

C. Hutchinson, chairman, ASME Board of Honors, presented for the Undergraduate Student Award for 1951, Philip Levine, Junior ASME, University of Connecticut 1951, a research intern, National Advisory Committee for Aeronautics, Langley Field, Va., for his paper, "An Experimental Analysis of Flame Propagation in Cylindrical Tubes." Mr. Pigott presented the certificate of award.

A drawing for door prizes concluded the luncheon.

## ANNUAL BANQUET

Nearly 1200 ASME members, their wives, and guests attended the Annual Dinner on Wednesday evening. The main social function of the Annual Meeting, the banquet was highlighted by the conferring of honors and awards to eminent engineers, bestowing of honorary ASME memberships, recognition of 50-year members of ASME, and introduction of incoming Council members, and the incoming president.

William L. Batt, Honorary Member ASME, head, Economic Cooperation Administration, American Embassy, London, England, and recipient of the Hoover Medal at the Honors Luncheon, was this year's banquet speaker. His inspiring and thought-provoking address, "Rediscovering America," will be published in a later issue.

Retiring President J. Calvin Brown, acting as toastmaster, called on ASME Secretary Clarence E. Davies who introduced the following honored guests in attendance at the dinner: Scott Turner, chairman of the Hoover Medal Board of Award; James M. Todd, president, Engineers Joint Council; Herman Weisberg, president, The Engineering Foundation; Carlton S. Proctor, president, American Society of Civil Engineers; John A. C. Warner, secretary and general manager, Society of Automotive Engineers; Dean L. E. Seeley, president, American Society of Heating and Ventilating Engineers; Capt. S. Paul Johnson, director, Institute of the Aeronautical Sciences; Paul H. Robbins, president, Society of Automotive Engineers; and Dr. L. Austin Wright, secretary, The Engineering Institute of Canada.

Regional vice-presidents elected and introduced by President Brown are: Willis F. Thompson, Region I, chief of mechanical engineering, Westcott and Mapes, Inc., New Haven, Conn.; Ernest H. Hanhart, Region III, consulting mechanical engineer, Baltimore, Md.; Ernest S. Theiss, Region V, assistant chief engineer, Davey Compressor Company, Kent, Ohio; and Samuel H. Graf, Region VII, (re-elected), director, Engineering Experiment Station, Oregon State College, Corvallis, Ore. Elected directors at large are Albert C. Pasini, superintendent, production department, The Detroit Edison Company, Detroit, Mich.; and Paul B. Eaton, head, mechanical engineering department, Lafayette College, Easton, Pa.

Incoming president R. J. S. Pigott, director of engineering research of Gulf Research and Development Company since 1929, received a standing round of applause when he was introduced by President Brown. Mr. Pigott has a long and distinguished professional record, which includes 11 years in the design, construction, and operation of central steam power stations; seven years in designing and constructing power and industrial plants; five years in metal manufacture, and 18 years in petroleum-engineering research, President Brown said.

In his brief acceptance remarks President-Elect Pigott pointed up the present shortage of engineers and called for the need of training many more to fulfill the needs of industry.

HONORARY MEMBERSHIP IN I.M.E. CONFERRED UPON SENATOR RALPH E. FLANDERS

(Honorary membership in The Institution of Mechanical Engineers of Great Britain was conferred upon Senator Ralph E. Flanders of Vermont, *second from left*, by Reginald J. S. Pigott, ASME president, who congratulates him as William L. Batt, *left*, minister in charge of the Economic Cooperation Administration to the United Kingdom, and Ervin G. Bailey, vice-president of The Babcock & Wilcox Co., of New York, look on. Mr. Batt and Mr. Bailey, who received the Hoover Medal and the John Fritz Medal, respectively, are both members of the I.M.E. Mr. Pigott acted for the president of the British engineering group.)

Proceeding to the recognition of 50-year members of ASME, President Brown called on Harvey E. Mole, John Stewart Thomson, and Elliott H. Whitlock, who were present at the dinner. They were presented 50-year buttons by President-Elect Pigott. Other 50-year members, not present, announced by President Brown were the following: John Glodding Aldrich, Robert W. Angus, Francis Eugene Blake, George I. Bouton, George A. Buvinger, Edma H. Curtis, Charles Stephen Gladden, John Dudley Hackstaff, Emanuel Hollander, Henry R. Kent, George Llgenfritz King, Louis C. Krummel, Henry Ackley Lardner, David Lofts, Daniel Tate MacLeod, Alvano T. Nickerson, Randolph Theodore Ode, Frederick William O'Neil, Ellis L. Phillips, Ward Raymond, George P. Richardson, William W. Sayers, Henry Dexter Sharpe, Edwin G. Stroud, Maxwell Mayhew Upson, and Charles F. Wieland.

Also introduced by President Brown were F. D. Herbert of the Old Guard, Senator Ralph E. Flanders, who was made an Honorary Member of The Institution of Mechanical Engineers of Great Britain; Thomas R. Jones, recipient of the Gantt Medal; and E. G. Bailey, who was awarded the John Fritz Medal. Present too and asked to rise was Arthur Williston who was attending his fifty-fourth consecutive ASME Annual Dinner.

Conferring of honors and awards were made to the following members of ASME:

Pi Tau Sigma Gold Medal Award to Warren M. Rohsenow, Jun. ASME, for outstanding achievement in mechanical engineering within ten years after graduation.

Richards Memorial Award to J. Kenneth Salisbury, Mem. ASME, for outstanding achievement in mechanical engineering within twenty to twenty-five years after graduation.

Junior Award to John D. Stanitz, Jun. ASME, for his paper, "Analysis of the Exhaust Process in Four-Stroke Reciprocating Engines."

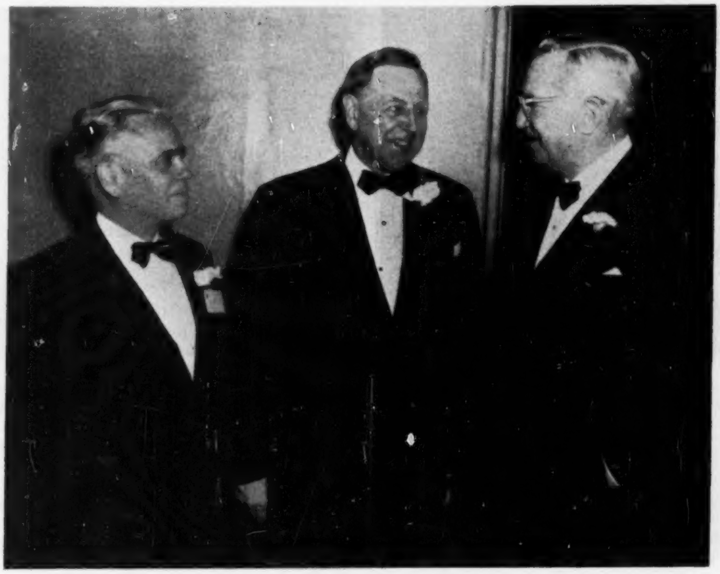
Melville Prize Medal for Original Work to Clayton H. Barnard, Mem. ASME, for his paper, "Gas Analyzers for Better Combustion."

Worcester Reed Warner Medal to Jacob P. Den Hartog, Mem. ASME, for outstanding contributions to engineering literature.

Holley Medal to George R. Fink, Mem. ASME, for unique acts of courageous engineering vision in conceiving and building a new steel plant and in developing and producing new and useful materials for armor and housing.

ASME Medal to Glenn B. Warren, Fellow ASME, engineer and leader in the science and art of turbine design.

Honorary Memberships in the Society were conferred upon Robert M. Gates, Fellow ASME, for "his brilliant and faithful service to the Society for over three decades and for his distinguished contribution to the engineering profession through his devotion to the ideal of unity and social responsibility"; Lewis F. Moody, Fellow ASME, eminent engineer, "distinguished teacher, and leader in hydraulics, a major contributor to the study of cavitation, the use of similarity in model testing, and in fluid flow"; Latham E. Osborne, Mem. ASME, for "his high professional attainment in the field of manufacturing, for his outstanding executive ability, and especially for his exceptional personal qualities of leadership, integrity, and warmth of human understanding of his fellow men"; Harry A. Winne, Mem. ASME, "a distinguished leader in engineering; indus-



AWARD OF ASME AND HOLLEY MEDAL

(*Left to right*, Glenn B. Warren, general manager, turbine divisions, General Electric Co., Schenectady, N. Y., awarded the ASME Medal, highest award of the Society, for "leadership in the science and art of turbine design"; Reginald J. S. Pigott, 1952 ASME president, and George Rupert Fink, president of the National Steel Corporation, Detroit, Mich., winner of the Holley Medal for "unique acts of courageous engineering vision in conceiving and building a new steel plant and in developing and producing new and useful materials for armor and housing."

trious, brilliant, graduating from Syracuse University with honors and rising to engineering vice-president of General Electric Company, serving his country in atomic energy and other national missions; a great asset to the engineering profession and in the selection and training of engineers."

Secretary Davies served as narrator and President-Elect Pigott made the presentations.

More complete details concerning the honors and awards can be found on pages 69–75 of this issue.

The Presidents' Reception, followed by dancing, concluded the program.

#### IIRD DINNER

The dinner on Monday evening, sponsored by the Industrial Instruments and Regulators Division, was held in an atmosphere of informality. No speeches were scheduled. Instead, the main portion of the dinner meeting was devoted to the presentation of a certificate of award by the Division honoring Charles S. Draper, Mem. ASME, professor of aeronautical engineering and director of instrumentation laboratory, Massachusetts Institute of Technology, Cambridge, Mass., for his accomplishments in advancing the theory and practice and teaching of instrumentation in the military, industrial, and scholastic fields. The presentation was made by Dr. C. E. Mason, Mem. ASME, who is a consulting engineer from Watertown, Conn. Dr. Mason received last year's award.

A. F. Sperry, Mem. ASME, president, Panellit Inc., Chicago, Ill., presided at the dinner.

#### APPLIED MECHANICS DINNER

A large and interested group of members of the Applied Mechanics Division attended the dinner of the Division which was held on Tuesday evening. L. H. Donnell, chairman of the Division, research professor of the Department of Mechanics, Illinois Institute of Technology, Chicago, Ill., presided, and received a certificate of award for his services to the Division. J. M. Lessells, editor of the *Journal of Applied Mechanics*, and Martin Goland, editor of *Applied Mechanics Reviews*, reported briefly on those publications.

The speaker was E. U. Condon, director of research, Corning Glass Company, Corning, N. Y., and his subject was "Some Thoughts on Scientific Research in the Federal Government." Dr. Condon expressed the opinion that the research activities of the government should be brought together under a single administrative head, preferably of cabinet rank, and gave cogent reasons for the adoption of his suggestion. He then directed his remarks to a discussion, with some case histories, of the workings of the loyalty investigations of government employees, and the anguish, injustice, and expense suffered by innocent victims.

#### HEAT TRANSFER LUNCHEON

The Heat Transfer Luncheon was held on Tuesday noon. G. L. Tuve, chairman of the Heat Transfer Division, presided, and the speaker was Ernst R. G. Eckert, professor of mechanical engineering, University of Minnesota, St. Paul, Minn., whose subject was "Progress and Problems in Aircraft Heat Transfer."

Professor Eckert said that in the textbooks on aeronautics of ten years ago, heat transfer was treated either in an appendix or not at all. Today this situation has radically changed, and the solution of heat-transfer problems is vital for many applica-

AT THE PRESIDENTS LUNCHEON

(*Left to right*, F. W. Miller, of the General Committee for the Meeting, L. R. Gaty, chairman of the Committee, and Ernest Hartford, Executive Assistant Secretary of the ASME.)

tions. So wide has the range of application become that it would be impossible for him to treat it completely in one lecture. Hence he had chosen to discuss a few high lights.

One obvious change in aeronautics in recent years, he said, is the tremendous increase in speed which has a marked effect on boundary layer and heat transfer. One aspect of this he explained by a discussion of the vortex or Hilsch tube and observations on the nature of the process which separates one air stream into two streams with different total temperatures. It is not generally recognized, he stated, that any high-velocity boundary layer acts in a similar way. His discussion of this process occupied a considerable portion of his address and will not be reported in this brief résumé.

Another characteristic of aeronautical applications to heat transfer discussed by Professor Eckert was interest in low densities encountered in such problems as the flight of rockets. He touched also on several aspects of heat exchangers, including the problem of finding effective low-weight exchangers, a subject of primary importance for aeronautical applications.

PRODUCTION ENGINEERING LUNCHEON

A narrative of the organization of a formal cost-reduction program in the engineering department of E. I. du Pont de Nemours & Company, Wilmington, Del., was given by Tom C. Gary, administrative assistant of du Pont's engineering department, on Tuesday during the luncheon meeting of the Production Engineering Division. He related that from a modest beginning 50 years ago in one division, the four operating divisions in the department are now organized for cost reduction. From this experience, he said, five prerequisites have been found essential for the effective organization of cost reduction. These are as follows: (1) Management leadership and support; (2) indoctrination to obtain the enthusiastic help of every person in the organization; (3) responsibility of line organization for accomplishment; (4) one or more capable young engineers, well-trained for the job, to devote full time in assisting line organization; (5) periodic financial and descriptive reports on accomplishments and goals.

Mr. Gary pointed out that these periodic reports must be reviewed immediately following the end of the period by management with supervision, and by supervision with all the workers. In this manner, he stated, we thus recognize good work, devise means to avoid any not-so-good work, and continually, through the exchange of ideas, seek new ways for cost reduction.

R. H. McCarthy, Mem. ASME, superintendent of manufacturing engineering of the Western Electric Company, Kearny, N. J., presided at the luncheon.

HYDRAULIC OLD TIMERS DINNER

As in previous years, an atmosphere of congeniality, gaiety, and festivity prevailed at the annual Hydraulic Old Timers Dinner on Tuesday evening. Led by Dwight G. Moorhead, who presided at the informal gathering, many stories, old and new, and reminiscences of early experiences were unfolded. Music and singing were also on the program.

FUELS LUNCHEON

Aspects of the petroleum industry and its accomplishments and objectives were discussed at the Fuels Luncheon on Tuesday by C. E. Davis, director of refining division, Petroleum Administration for Defense, Washington, D. C., the principal speaker. He reported that the petroleum industry of the United States has accomplished the following in the past five-year period, from 1946 to 1950: (1) Produced 10.2 billion bbl of crude oil and natural-gas liquids. (2) Increased proved reserves of all petroleum liquids by more than 6.5 billion bbl, after replacing with new reserves the 10.2 billion bbl produced during that period. (3) Increased availability of all petroleum liquids to 7,300,000 bbl daily in January, 1951, and to an estimated range of 7,409,000 to 7,566,000 bbl daily for the year 1951, compared with production in 1946 of 5,074,000 bbl daily, which was then about the availability at maximum efficient rates. (4) Produced 29.7 trillion cu ft of natural gas. (5) Increased proved reserves by 37.8 trillion cu ft, after replacing with new reserves the 29.7 trillion cu ft produced during that period. (6) Increased natural gas from 4.9 trillion cu ft in 1946, to 6.9 trillion cu ft in 1950. (7) Increased availability to an estimated 8.1 to 9.5 trillion cu ft annually in 1951.

According to Mr. Davis, crude-oil productive capacity has been rising steadily during most of the last 30 years, since the production rate in 1950 was more than four times that of 1920. The greatest portion of U. S. crude oil is being produced in states whose regulatory bodies will not permit production in excess of maximum efficient rates. In many unregulated areas, moreover, the fields are operated at conservative rates by the operating companies which, for the most part, are well aware

AT THE FUELS LUNCHEON

(R. J. S. Pigott, *center*, congratulates Earle C. Payne *left*, and H. F. Hebley *right*, on being made Fellows of the ASME.)

C. E. DAVIS AT THE FUELS LUNCHEON
(Carl E. Miller, *right*, presided.)

of the adverse effects of excessive production rates in ultimate recovery.

Early in 1951, Mr. Davis said, a study of the productive capacity of the U. S. was made by the Petroleum Administration for Defense. The P.A.D. analysis indicates the following average productive capacity in barrels per day, excluding natural-gas liquids: 1951—6,830,000; 1952—7,140,000; 1953—7,415,000; 1954—7,645,000; and 1955—7,845,000.

The rising trend in productive capacity may eventually end, and a period of static or declining capacity may ensue, but there is no evidence to indicate that this time is approaching, he stated. Oil is still being found in new geologic provinces, and as yet, other large provinces are practically untested.

Furthermore, Mr. Davis declared, large potential reserves undoubtedly exist even in the more highly developed areas at depths which in the past have been beyond the reach of the drill. As drilling techniques continue to improve, he said, it will be possible to discover and develop these deeper reserves.

As part of the luncheon program, both Earl C. Payne and Henry F. Hebley were presented with ASME Fellowship certificates by R. J. S. Pigott, ASME president-elect.

Carl E. Miller, Mem. ASME, manager of the stoker division of Combustion Engineering-Superheater Company, New York, N. Y., officiated at the luncheon.

TEXTILE LUNCHEON

Some of the reasons for the variations in the 1951 cotton crop were discussed by Joseph M. Leahy, director of research, Volkart Bros., Inc., New York, N. Y., at the Textile Division luncheon on Friday. He pointed out that these differences are chiefly genetic or the basic difference between the principal varieties grown and environmental or the effect of location and weather.

Cotton production is approximately a four months' operation, yet the length of the staple is determined in from 13 to 20 days, Mr. Leahy said. Near perfect weather conditions are necessary for a variety to produce its maximum or inherited staple length. Stress for water within the plant usually produces shorter cottons than one would reasonably expect from a given variety. There are compensating factors however, and nature has the ability and habit of enhancing one characteristic in cotton when she penalizes another. In this instance, where slight water stress shortens fiber length, the tensile strength and fineness are improved.

Weather also plays an important role in the development of the thickening phase of the secondary walls which begins immediately after elongation. In this process, sugar, produced from water and carbon dioxide, by the action of sunlight on the plants' leaves, is carried into the fibers and chemically converted into cellulose. Actually, he said, we have a combination of natural forces at work in a cotton plant manufacturing cellulose and these forces are governed by weather. In the production of quality cotton, weather is as important as the power switch in a textile plant.

In general, Mr. Leahy observed, it seems that about 70 per cent of the crop has been harvested and should be of excellent character. This does not imply that the remaining cotton will be altogether bad, but the adverse weather experienced throughout the belt during November, 1951, will have its effect on much of the cotton now in the field as well as the new crop estimate.

R. O. Palmer, Mem. ASME, Carlyle Johnson Machine Company, Shrewsbury, Mass., presided at the luncheon.

ROCKET DINNER

The annual dinner of the American Rocket Society, held on Thursday evening, was highlighted by the presentation of honors and awards to various members of the ARS for their achievements in furthering the development of rocketry. A. S. Alexander, Undersecretary of the Army, was the principal speaker.

The following awards were presented at the dinner: The Goddard Memorial Lecture Award to Commander R. C. Truax, USN; C. N. Hickman Award to Dr. William H. Avery, Applied Physics Laboratory, The Johns Hopkins University; and the first presentation of the G. Edward Pendray Award was made to George P. Sutton, consultant, North American Aviation, Inc. The ARS Student Award went to David Elliott and Leo Rosenthal of the California Institute of Technology, who could not be present.

Fellow memberships in the ARS were presented to E. H. Hull, Chandler C. Ross, and Col. H. N. Toftoy, USA, at the dinner.

Charles E. Bartley and Benjamin F. Coffman, Jr., were also made Fellows but were not present.

In his talk, Mr. Alexander called for surface-to-surface missiles, initially to extend the capabilities of Army artillery and to replace some of the heavier types. Surface-to-surface missiles

CHARLES S. DRAPER, *right*, RECEIVES TESTIMONIAL OF APPRECIATION FROM IIR DIVISION
(C. E. Mason, *left*, and A. F. Sperry, *center*.)

C. E. DAVIES, J. CALVIN BROWN, AND J. D. CUNNINGHAM AT PRESIDENT'S LUNCHEON

will reach out well beyond the range of any known artillery and strike into the rear areas of the enemy's forces, he said. The surface-to-surface missile will also supplement and will probably replace many of the tasks of air support, particularly on those missions that have to be performed over areas with strong antiaircraft defense, or over rough terrain as in Korea, or for pin-point targets day or night in all kinds of weather. Not only must these missiles deliver an atomic warhead of appropriate size, but they must also, for the many missions they might be called upon to undertake, be always considered as carriers of other kinds of warheads, conventional or otherwise, he declared.

To carry out the Army's military and civilian air-defense responsibilities, Mr. Alexander stated that we require surface-to-air missiles which can reach out further and more effectively than anything we can reasonably hope for now or in the future from conventional antiaircraft artillery. Although the latter are constantly being improved as to accuracy, range, warhead lethality, and rate of fire, they can never be expected to handle adequately high-speed maneuvering aircraft at the higher altitudes.

A requirement particularly important to the Army in both the surface-to-surface and a surface-to-air program is for equipment that can be transported, launched, and maintained under isolated and rugged field conditions, he said. Furthermore, since we cannot man our missile units with PhDs, the weapon must be as simple and reliable as possible.

Until these missile types become fully available, the Army cannot let up one iota on the production and further refinement of existing weapons. In spite of all the promise of guided missiles, he warned that we must remain skeptical until they and all their ground equipment have been proved in quantity not only in the hands of the technical people, but by the troop units that will have to be ready to fight with them. The vital question as to whether a missile-equipped Army can safely be of smaller size and less costly must necessarily wait for some time before it can be accurately answered. The same is true for the question of what present-day weapons will be made obsolete. We would like to predict an eventual reduction of demands for manpower and money, but it is far too early in the game to be able to say how much and when, he declared.

H. R. J. Grosch, retiring president of the ARS, acted as toastmaster. Elected to serve as new president of the society was C. W. Chillson of the Curtiss-Wright Corporation, East Caldwell, N. J.

## ROY V. WRIGHT LECTURE

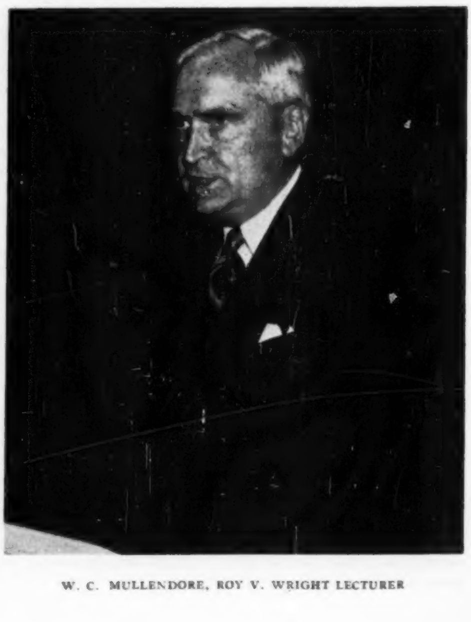
Speaking with vigor and conviction to a large and receptive audience on Tuesday afternoon, Nov. 27, 1951, W. C. Mullendore, president, Southern California Edison Company, Los Angeles, Calif., delivered the Roy V. Wright Memorial Lecture on "The American Retreat From Freedom."

R. J. S. Pigott, president ASME, presided, and called upon J. Calvin Brown, past-president ASME, to introduce Mrs. Roy V. Wright who spoke briefly. She said that Roy V. Wright, a former president and Honorary Member of ASME, had devoted his leisure time to taking part in civic and political affairs on behalf of this country. When he had become interested in these activities, she stated, he was impressed by the fact that engineers took little responsibility in them and that he himself knew little about such matters. Accordingly, he assembled a library of references, he conducted a course in the Newark College of Engineering, and spoke extensively on the subject of the civic responsibility of the engineer as he visited the ASME Sections during his term of office as president. Such work, she asserted, took time, energy, enthusiasm, and devotion.

Mr. Mullendore was introduced by James D. Cunningham, past-president ASME. In the course of his address, Mr. Mullendore stated that a small but powerfully placed minority in this country had placed the nation in great danger by committing it to bear the burdens of the world. He deplored the progress already made toward socialism in this country and called upon engineers to exert influence to stem the "American retreat from freedom."

"Our first duty," he said, "is not to those suffering from the results of centuries of misguidance and tyranny, for which we are not responsible and from which our forefathers fled, but rather our first duty is to preserve the hope and opportunity for the individual American citizen which are dependent on the free institutions of our own country.

"We cannot save others by tearing ourselves down," he



W. C. MULLENDORE, ROY V. WRIGHT LECTURER

J. T. RETTALIATA RECEIVES AWARD OF GAS TURBINE POWER DIVISION

(The award was presented for pioneering work on the gas turbine by Prof. W. J. King, *l.fs*, of the University of California, Los Angeles.)

continued, "We cannot advance the cause of human freedom and progress by recklessly overcommitting ourselves to carry the burdens imposed upon foreign nations by the accumulated errors of centuries. And if this be isolationism, then we should be proud indeed to bear the name."

## SPECIAL SOCIAL EVENTS

Besides the regularly scheduled luncheons and dinners, numerous other social activities were arranged for by the Entertainment Committee. On Sunday afternoon, ASME members and their guests were all invited to the opening tea; a welcoming reception took place on Monday afternoon; a tea dance, tendered by the Woman's Auxiliary, was well-attended on Tuesday afternoon; and on Tuesday evening everyone was invited to join the Monte Carlo games party at which many valuable prizes were awarded to the lucky winners.

### COLLEGE REUNIONS

With engineers in Atlantic City for the 1951 ASME Annual Meeting from all over the United States, seven schools availed themselves of the opportunity to hold college reunions and exchange news and views. These meetings were held in conjunction with either a luncheon or dinner in one of the many attractive dining rooms in the Chalfonte-Haddon Hall. Reunions were held by the following schools: University of California, The Johns Hopkins University, Cornell University, University of Michigan, Stevens Institute of Technology, Northeastern University, and Purdue University.

### SCIENCE THEATER

Daily showings of some 48 industrial films, many in color, was one of the high lights of the Annual Meeting. The films depicted equipment, materials, processes, design, and many other features of interest to engineers. Included were such films as "Copper," by Anaconda Wire and Cable Company; "This is Aluminum," by Aluminum Company of America; "Treasure From the Sea—Magnesium," by U. S. Bureau of Mines; "Development of Steam," by The Babcock & Wilcox Company; "Type 'E' Turbines," by Westinghouse Electric Corporation; "Clean Waters," by General Electric Company; "Engineering for Radioisotopes," by Atomic Energy Commission; "More Power for America," by Combustion Engineering-Superheater Company; "Synthetic Rubber," by U. S. Bureau of Mines; "Stainless Steel," by U. S. Bureau of Mines; "Jet Propulsion," by General Electric Company; "The Centrafire—Spreader Stoker," by Westinghouse Electric Corporation; and many others.

## TECHNICAL PROGRAM

The record technical program scheduled at this year's Annual Meeting during which more than 220 papers were presented at some 90 technical sessions, revealed a vast fund of new information on engineering techniques and developments. Featured were numerous symposiums and panel discussions on such subjects as pulsation in fluid measurement; training young engineering graduates in industry; education of production engineers; strength through productivity, including productivity through facilities, manpower, and control; effect of lubricating oil upon Diesel and gas-engine performance; a production engineering clinic which covered purchase engineering, equipment, and tooling; production processes, inspection, quality control, production specifications, wages, salvage, and process development; a discussion of the low-load operation of spreader stokers; in hydraulics a panel discussion was conducted on the acoustic vibration in reciprocating compressor systems; and the textile group offered a symposium on opening and picking by the Aldrich, Saco-Lowell, and the Whitin systems.

In addition, the ASME Materials Handling Division together with the Society of Industrial Packaging and Material Handling Engineers and the American Material Handling Society sponsored two technical sessions covering belt-conveyer usage in industry, development of conveyer belting, and studies of efficient plant layout for materials handling.

In the field of gas-turbine power it was revealed that an aircraft engine of the two-stroke-cycle gas-generator type would

MARTIN D. WHITAKER, PRESIDENT LEHIGH UNIVERSITY, SPEAKER AT MONDAY EVENING SESSION FOR YOUNG ENGINEERS

WINNERS OF MOST COVETED ENGINEERING HONORS IN THE UNITED STATES

(The recipients, *left to right*, were Thomas R. Jones, president of Daystrom, Inc., of Elizabeth, N. J., Henry Laurence Gantt Medal for "distinguished achievement in industrial management as a service to the community"; William L. Batt, minister in charge of the Economic Cooperation Administration to Great Britain, the Hoover Medal for "leadership in engineering, management, and public responsibility, and his many distinguished services to his community and the nation;" Ervin G. Bailey, vice-president of The Babcock & Wilcox Co. of New York, N. Y., the John Fritz Medal for "outstanding engineering achievements in the field of combustion and distinguished service to his fellows in advancing the engineering profession.")

provide a power plant of low specific weight and fuel consumption with favorable altitude-performance characteristics. Papers in steam power covered reheat and nonreheat modern large turbine-generator units, service experience and recent design progress with modern reheat turbines, and operation performance and design of reheat boilers. A series of papers sponsored by the Aviation Division discussed roller bearings at high speeds, bearing-lubrication problems in aircraft gas turbines, performance characteristics of ball and roller bearings, and the life of high-speed ball bearings. Operating experience of the Talgo train, the history and development of the 567 series General Motors Diesel locomotive engine, and the annual progress report on railway mechanical engineering were feature topics on the railroad program.

Other fields covered at the ASME Annual Meeting included applied mechanics, heat transfer, industrial instruments, rubber and plastics, cutting fluid, machine design, metals engineering, petroleum, wood technology, lubrication, process industries, safety, boiler-feedwater studies, vessels under external pressure, effect of temperature on metals, and high-temperature steam generation.

As in the five previous years, the American Rocket Society again held its annual convention in conjunction with the ASME. The ARS technical program consisted of 18 papers which were presented at five technical sessions. Some of the topics included altitude stabilization for supersonic vehicles, dynamic launching techniques for testing aircraft rockets, rocket-engine installations, problems in high-pressure combustion, and others.

Pages 76–78 contain a list of ASME preprints made available at the Meeting. The list is arranged according to divisions and committees. In the ASME Technical Digest section of

REGINALD J. S. PIGOTT, ASME PRESIDENT, *left*, AND CARLTON PROCTOR, PRESIDENT OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS, SHOWN AT THE 1951 ANNUAL MEETING OF THE ASME

this issue of MECHANICAL ENGINEERING, 48 digests of ASME Annual Meeting preprints appear. Digests of the remaining available papers will be published in the ASME Technical Digest section of forthcoming issues of MECHANICAL ENGINEERING.

Pamphlet copies of the preprints are available from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. When ordering, please give title, author, and paper number. Price, 25 cents per copy to ASME members.

#### NUCLEAR ENERGY

Under the auspices of the ASME Nuclear Energy Applications Committee, T. Keith Glennan, a member of the U. S. Atomic Energy Commission, Washington, D. C., gave an address on Thursday afternoon on "Industry and the Atomic Energy Commission." President Pigott presided and Mr. Glennan was introduced by John R. Dunning, dean of engineering, Columbia University, and a member of the ASME committee.

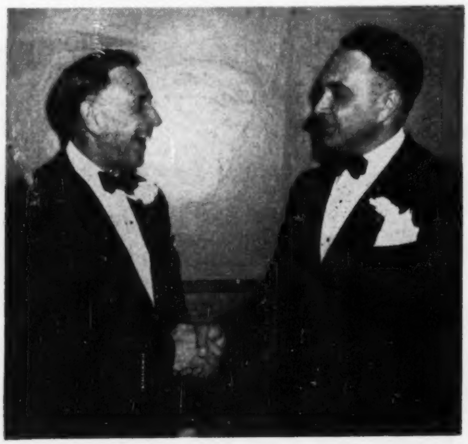
Mr. Glennan recalled the numerous ways in which ASME had been of service to the Commission. His plea was for industry to enter more freely and effectively into the field of atomic-energy developments. The full text of his address will be published in a later issue of this magazine.

J. CALVIN BROWN, OF LOS ANGELES, *left*, RETIRING PRESIDENT OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, CONGRATULATES REGINALD J. S. PIGOTT, OF PITTSBURGH, WHO TOOK OVER THE REINS OF ASME PRESIDENT FOR 1952 AT THE 72ND ANNUAL MEETING OF THE SOCIETY IN ATLANTIC CITY

### COMMITTEES IN CHARGE

Meetings of The American Society of Mechanical Engineers come under the general supervision of the Meetings Committee. The technical program is provided by the Society's professional divisions and technical committees. Other features are planned and supervised by committees organized within the host Section, in this case the Philadelphia Section. In grateful acknowledgment of the many committees whose efforts contributed so substantially to the success of the 1951 Annual Meeting, their personnel is listed as follows:

Meetings Committee: Allen W. Thorson, chairman; Robert H. Bacon, Roland W. Flynn, J. Keith Louden, Willis F. Thompson, and G. R. Fryling and H. D. Moll, junior advisers.



PRESIDENT PIGOTT PRESENTS MELVILLE MEDAL TO C. H. BARNARD

Clayton H. Barnard, *right*, application engineer, Bailey Meter Co., of Cleveland, Ohio, is congratulated by Reginald J. S. Pigott, ASME president, upon receiving the Society's Melville Prize Medal for the "best original paper or thesis on any mechanical-engineering subject presented before the ASME the previous year." Mr. Barnard received the award for his paper "Gas Analyzers for Better Combustion.")

Board on Honors: Ely C. Hutchinson, chairman; Lionel J. Cucullu, Joseph B. Ennis, Paul E. Holden, Ernest L. Hopping, and Warner Seely.

Medals Committee: Ely C. Hutchinson, chairman; L. M. K. Boelter, Lionel J. Cucullu, Joseph B. Ennis, Tomlinson Fort, Arthur E. Grunert, H. Drake Harkins, Paul E. Holden, Ernest L. Hopping, Alfred Iddles, J. Stanley Morehouse, L. F. Nenninger, Morrough P. O'Brien, William H. Oldacre, R. J. S. Pigott, Frank Prouty, Warner Seely, C. Richard Soderberg, Ralph E. Turner, Robert M. Van Duzer, Jr., and Gerald V. Williamson.

General Committee: L. R. Gaty, chairman; C. B. Campbell, vice-chairman; S. Littlejohn, treasurer; W. E. Belcher, Jr., W. F. Coles, Jr., C. M. Hagan, T. W. Hopper, E. L. Hopping, K. M. Irwin, B. F. Keene, S. T. MacKenzie, J. J. McCarthy, Mrs. R. W. Worley, F. W. Miller, H. D. Moll, D. W. R. Morgan, A. W. Thorson, and B. W. Webb.

Information and Reception Committee: Thomas W. Hopper, chairman; W. G. Allen, R. E. Barney, Frank G. Feeley, Jr., F. C. Frolander, Sigmund Kopp, William G. McLean, Thomas E. McMahon, E. P. Nye, M. C. Randall, Carl H. Rulfs, E. A. Schumann, Jr., S. B. Sexton, III, Bowman Snavely, and William W. Starke.

Science Theater Committee: W. F. Coles, Jr., chairman; Robert E. Derby, vice-chairman; Frank Convey, Stephen P. Higgins, Walter Locke, Robert H. Stevens, and Robert Westman.

Entertainment Committee: W. E. Belcher, Jr., chairman; George H. Auth, vice-chairman; Louis J. Brown, Karl M. Busler, Joseph P. Clark, A. John Erlacker, Hans Gartman, William J. Healy, Frederic A. Lang, David W. Locke, Garner C. Parr, James A. Quaid, Arthur M. Quinn, Jesse Taylor Jr., and H. M. Wilson.

Annual Banquet Committee: B. W. Webb, chairman; Waldo Caven, Tom Mullen, and C. S. Robinson.

Ushers: George J. Nicastro, chairman; J. W. Bennett, R. S.

AT THE TEA DANCE ON TUESDAY AFTERNOON

Biddle, Robert Bley, C. H. S. Butler, J. R. Casey, Dexter Cobb, D. M. Demarest, J. R. Hamm, D. G. Hubert, W. H. Jackson, H. M. Lawson, S. Lemezis, T. J. McGowan, J. W. McNeese, H. D. Moll, J. H. Olson, R. D. Perry, R. D. Phillips, E. M. Powell, B. Wagner, and A. R. Weismantle.

Reception for Honored Guests Subcommittee: E. L. Hopping, chairman; W. M. Sheehan, vice-chairman; J. M. Barnes, C. W. E. Clarke, J. H. Harlow, L. P. Hynes, and Stanley Morehouse.

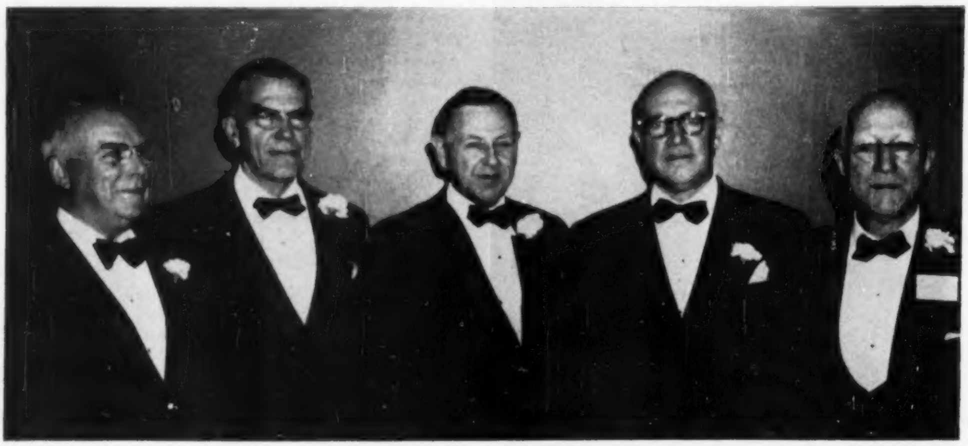
Committee on Women's Activities: Mrs. R. W. Worley, chairman; Mrs. G. S. Gethen, Mrs. F. W. Miller, Mrs. J. J. McCarthy, Mrs. W. M. Sheehan, and Mrs. A. W. Thorson.

Publicity Committee: Burton F. Keene, chairman; George S. Gethen, vice-chairman; C. M. Hagan, William H. Jackson, Garner C. Parr, Albert Schade, 3rd, and Robert W. Worley.

Technical Events Committee: Justin J. McCarthy, chairman; Hans Gartman, T. N. Graser, William Hunter, William S. Major, Daniel J. Keating, Jr., Albert Schade, 3rd, and Henry Sorg.

Student Aids Committee: H. D. Moll, chairman; Arthur Hughes, co-chairman; R. T. Vogdes, vice-chairman; Sylvester Lemezis, and Carl Newman.

Finance Committee: F. W. Miller, chairman; G. M. Barnes, Spencer T. Bunting, Hans Gartman, Charles S. Gotwals, H. D. Harkins, K. M. Irwin, Samuel Littlejohn, Sidney T. MacKenzie, Justin J. McCarthy, D. W. R. Morgan, Ezra K. Nicholson, Carrington B. Phillips, Coleman Sellers, 3rd, William M. Sheehan, and Benjamin W. Webb.



PRESIDENT R. J. S. PIGOTT AND FOUR NEWLY MADE HONORARY MEMBERS OF THE ASME

(Reginald J. S. Pigott, ASME president, *center*, with four newly made honorary members of the Society. *Left to right*, Robert M. Gates, president, Air Preheater Corporation, New York, N. Y.; Harry A. Winne, vice-president in charge of engineering policy, General Electric Co., Schenectady, N. Y.; Latham E. Osborne, vice-president of manufacturing and general products, Westinghouse Electric Corporation, Pittsburgh, Pa., and Lewis F. Moody, professor emeritus, Princeton University, Princeton, N. J.)

# ASME HONORS ENGINEERS

## *Biographies of Recipients of Honorary Membership and Awards at the 1951 ASME Annual Meeting*

EVERY year The American Society of Mechanical Engineers honors distinguished members of the engineering profession by the presentation of certificates of honorary membership and the prizes and awards that have been instituted from time to time during the course of the Society's existence. The bestowal of these certificates, prizes, and awards is a colorful feature of the ASME Annual Dinner where the attendance this year exceeded 1200 persons. A description of the dinner and a list of the recipients of honorary-membership certificates, prizes, and awards will be found on other pages of this issue. In the following pages brief biographies are presented so that members of the Society may know what manner of men they have honored.

### HONORARY MEMBERS

*Norris R. Crump.* One of Canada's most distinguished engineers, Norris Roy Crump, has devoted his entire career to the service of the Canadian Pacific Railway, of which he is executive vice-president.

After graduation from high school in Revelstoke, B. C., where he was born in 1904, he began work for the C.P.R. on the car repair track there. Later, while a machinist apprentice in the Winnipeg shops, he took additional evening courses to cover college-entrance requirements. He secured a BS degree in mechanical engineering at Purdue University in 1929, and during the ensuing years the C.P.R. gave him assignments of ever-increasing responsibility. His election to his present office in 1949 brought him to one of the highest executive positions in Canada. He is also president of the subsidiary companies, Dominion Atlantic Railway, Quebec Central Railway, Eastern Abattoirs, Ltd., and Canadian Pacific Transport Company, and his directorships include the Canadian Pacific Air Lines, Canadian Pacific Express Company, and Canadian Pacific Steamships, Ltd.

Dr. Crump keeps in close touch with the industrial and economic development of all sections of Canada and is much in demand as a speaker at public functions, not only in railway circles, but also among business and professional groups generally.

He is a member of The Engineering Institute of Canada, the Professional Engineers of Quebec, the Executive Council of the Canadian Chamber of Commerce, the Dollar-Sterling Advisory Council, and the Montreal Board of Trade.

Purdue University conferred an ME degree upon Dr. Crump in 1936 and he received the honorary degree of Doctor of Laws from Queen's University in 1950.

*(Honorary Membership in the ASME was conferred upon Dr. Crump during the ASME Semi-Annual Meeting in Toronto in June, 1951.)*

*Robert M. Gates.* A member of the ASME since 1918 and a Fellow since 1936, Robert McFarland Gates has rendered outstanding service to the Society. He has played a considerable part in the formation and development of the professional divisions and in the work of the Meetings and Program Committee. His participation in numerous other committee activities has been of great constructive value and he has ably represented the Society on various joint bodies looking toward greater unity of the engineering profession. He was a manager, of the Society, 1928–1931, vice-president, 1931–1933, and president, 1943–1944.

Dr. Gates has been located in the East since 1918, but he was born in O'Brien County, Iowa, in 1883. His father's death caused economic problems which delayed his college entrance. He obtained a BS degree in mechanical engineering from Purdue University in 1907. The honorary degree of Doctor of Engineering was conferred by the University in 1944.

His early experience in engineering in Ohio included consulting practice with James H. Herron. In 1918 the Lakewood Engineering Company, of Cleveland, appointed him eastern manager at Philadelphia, Pa. Four years later he became manager of the industrial department of The Superheater Company, New York, N. Y., and later was made vice-president of it and in 1933 of the Combustion Engineering Company, Inc. He has been president of The Air Preheater Corporation since 1940.

During World War II Dr. Gates led the Society's work in connection with the conservation of industrial materials and war production. Since the war he has served with the U. S. National Commission for UNESCO and the Commission on Technical Assistance to the State Department and the United Nations.

His wide experience has been set forth in numerous articles and addresses, and many young students and engineers have had the benefit of his counsel.

*Lewis F. Moody.* Linked closely to developments in hydraulic engineering is the name of Lewis Ferry Moody. To his credit are nearly one hundred patents, including the spreading draft tube for the regain of hydraulic energy, a high-speed propeller turbine with low cavitation factor, and the propeller-type "spiral" pump. He introduced an exponential formula for relating hydraulic-turbine efficiencies and developed a cavitation theory which led to the Thoma factor.

His chief connection in industry has been with the I. P. Morris Co., Philadelphia, Pa., for which he began work in 1904. Since 1911 he has served it and related companies (Cramp Shipbuilding and Baldwin Locomotive) in a consulting capacity, on either a part or a full-time basis. He has also engaged in other consulting work, particularly for the Worthington Pump and Machinery Corporation.

Mr. Moody was born in Philadelphia in 1880. He received a BS degree in 1901 and an MS the following year from the University of Pennsylvania and subsequently was instructor there for two years. He was on the faculty of Rensselaer Polytechnic Institute from 1908 to 1916, and professor of hydraulic engineering at Princeton University from 1930 until his retirement in 1948.

A member of the ASME since 1910 and a Fellow since 1944, he has served as chairman, Philadelphia Section; member, Power Test Codes Committee, and Council representative, Board on Honors; a founder and chairman, Hydraulic Division; and director at large of the Society, 1946–1948.

He is also a Fellow of the AAAS and a member of The Frank-

# Made Honorary Members of the ASME

NORRIS R. CRUMP
*Honorary Membership*

ROBERT M. GATES
*Honorary Membership*

LEWIS F. MOODY
*Honorary Membership*

HARRY A. WINNE
*Honorary Membership*

LATHAM E. OSBORNE
*Honorary Membership*

lin Institute (which awarded him the Elliott Cresson Medal in 1945) and of the ASEE, Sigma Xi, and Tau Beta Pi.

Mr. Moody has contributed many papers to the publications of the engineering societies and also prepared the section on hydraulic machinery of the 1942 Handbook of Applied Mechanics (McGraw-Hill).

*Latham Edgar Osborne*, whose talent for increasing manufacturing efficiency and encouraging engineering development has played a significant role in the electrical industry, is completing his forty-first year with the Westhinghouse Electric Corporation.

Born in Verona, a Pittsburgh suburb, in 1895, Mr. Osborne carried on correspondence-school studies in mechanical engineering and industrial management during his first years with Westinghouse. In the early 1930's he was works manager of the Meter Division, Newark, N. J., and of the East Springfield, Mass., appliance plant, and in 1939 he was named manager of manufacturing and engineering for the entire Electric Appliance Division, with headquarters at Mansfield, Ohio. It was in 1939, too, that he was awarded the Westinghouse Order of Merit, highest honor accorded an employee of the company.

Mr. Osborne was given leave in 1941 to serve as chief of heavy ordnance in the Office of Production Management. Upon his return in November he became manager of the steam division at South Philadelphia, Pa., and in 1942 he was elected vice-president in charge of the operations there. The development of jet aircraft engines for the U. S. Navy had been initiated by him in 1941, and in 1945 he organized a new aviation gas-turbine division at South Philadelphia. From 1943 to 1946 he was also

responsible for the merchant marine division, operated for the U. S. Maritime Commission.

In 1946 Mr. Osborne was transferred to Pittsburgh as senior operating vice-president. Three years later he received a staff assignment as vice-president in charge of manufacturing and direct-line responsibility for operations of the general products division. His present title is executive vice-president. He is also a director of the Baldwin-Lima-Hamilton Corporation and Baldwin Securities Corporation.

Mr. Osborne has been a member of the ASME since 1943.

*Harry A. Winne.* Upon his graduation in electrical engineering from Syracuse University in 1910, Harry Alonzo Winne became student test engineer with the General Electric Company. Since 1945 he has been vice-president of the company in charge of engineering policy. His progress led through the power and mining-engineering department and the steel-mill section of the industrial-engineering department to his appointment as sales manager of the combined mining and steel section in 1936. The next year he became general assistant to R. C. Muir, then vice-president in charge of engineering. Election to a vice-presidency came in 1941, when he was placed in charge of design engineering for the apparatus department.

Under his direction, during World War II, the central gunnery control for the B-29 Superfortress, the automatic pilot, the turbosupercharger, and aircraft jet engines were developed. Early in 1946 he was appointed by Secretary of State Byrnes to a Board of Consultants to aid the Committee on Atomic Energy, and in the present year he has been assigned to the responsibility for the G.E. nucleonics department and also for the company's general engineering laboratory at Schenectady. Late in 1950 he was named by the National Security Resources Board to serve on a scientific manpower advisory board.

About forty patents have been taken out in Dr. Winne's name, and much of his experience has been set down by him in papers for various engineering publications. He has received honorary doctor's degrees in engineering from Newark College of Engineering (1949) and Renssalaer Polytechnic Institute (1947), and in science from Syracuse University (1947). He is a trustee of Syracuse and R.P.I., and also of Green Mountain Junior College.

Dr. Winne became a member of the ASME in 1937 and a Fellow in 1950. He is also a Fellow of the AIEE, and a member of the ASEE. He is a native of Cherry Valley, N. Y., where he was born in 1888.

## RECIPIENTS OF MEDALS AND AWARDS

### ASME MEDAL 1951

*Glenn B. Warren.* For as long as he can remember, Glenn Barton Warren has been interested in science and engineering. He was born in Missouri in 1898, but the family moved to Girard, Kan., when he was three. While in high school there he built and operated two gas-turbine combustion chambers, and at the University of Wisconsin, from which he received a BS degree in mechanical engineering in 1919 (ME later), he built two more, on which extensive tests were run, partly as a thesis project. This experience and vacation work with Allis-Chalmers and General Electric led to his selection as a test student by the latter company following his graduation. Subsequently he directed the work being initiated on the internal aerodynamics and thermodynamics of steam-turbine design.

Later advancements in position made him responsible for the design of large public-utility and industrial turbines and main propulsion machinery for naval combat vessels. He was also associated in the design and development of aircraft gas turbines with axial-flow compressors for the U. S. Air Corps. After experience in the turbine, turbine-generator, and gear divisions of the company he was made general manager of these divisions in 1949.

Mr. Warren's leadership in developing lightweight turbines won him the G. E. Coffin Award in 1946, and a commendation from the Bureau of Ships, U. S. Navy, in 1948. Some forty patents and numerous contributions to the technical literature record his achievements.

Mr. Warren was elected to membership in the ASME in 1924 and has taken an active part in its affairs, serving on many committees, both local and national. He was made a Fellow in 1946. He is a member of the Advisory Committee on Steam Turbines, International Electrotechnical Commission, and of the Society of Naval Architects and Marine Engineers' and American Society of Naval Engineers, also of Tau Beta Pi and Pi Tau Sigma.

### HOLLEY MEDAL

*George Rupert Fink*, president of the National Steel Corporation, is the man who had the engineering ability, coupled with the foresight and courage, necessary to build the huge plant of the Great Lakes Steel Corporation on 275 acres of marshland in Ecorse, Detroit, Mich. Prior to this achievement he had risen from a steel-mill worker, at the age of thirteen, for the Allegheny Steel Company, to be its general sales manager. Then in 1923 he organized the Michigan Steel Corporation and built a plant for it at Ecorse. The Great Lakes Steel Corporation and the parent company, National Steel Corporation, for it and for Michigan Steel were organized by him in 1929.

Having built the Great Lakes plant on the only available Detroit site having the size and the rail and water connections needed for a large steel plant, Dr. Fink devoted it for the first ten years primarily to the production of automobile sheets. Then he directed his organization of engineers and metallurgists in the development of two new products which were to be manufactured there.

One of these was steel framing for houses, to replace wood framing. This "Stran Steel" was used for the wartime Quonset huts and more recently has been employed for the low-cost G.I. houses, known as the Brighton, and for other dwelling and industrial units. The other product was a high-strength steel requiring a low precentage of strategic alloy elements. This steel has been used for armor plate for combat vehicles and landing craft during World War II and the Korean War and is valuable for peacetime use because of its conservation of basic raw materials.

Dr. Fink was born in Brackenridge, Pa., in 1886. He served as a captain in the Ordnance Department, U. S. Army, in 1918. His noteworthy achievements in the steel industry brought him an honorary Doctor of Engineering degree from the University of Michigan in 1941. He became a member of the ASME two years later.

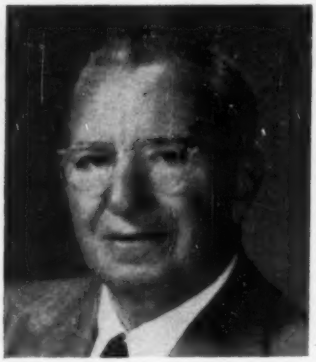
### WORCESTER REED WARNER MEDAL

*J. P. Den Hartog.* A specialist in the subject of vibrations and dynamics of machines, Jacob Pieter Den Hartog has made many contributions to the literature in this field. Of particular importance is his book "Mechanical Vibrations," first published in 1934 and now in its third English edition and also available in French, German, and Russian. More recent texts are "Mechanics and Strength of Materials," and his forthcoming "Advanced Strength of Materials." Many of his technical papers and book reviews have appeared in the publications of the ASME, in which he has held membership since 1929. He is past-chairman of the Applied Mechanics Division.

Born in Java in 1901, Dr. Den Hartog went to Holland with

# Recipients of Medals and Awards

GLENN B. WARREN
*ASME Medal*



GEORGE R. FINK
*Holley Medal*

J. P. DEN HARTOG
*Worcester Reed Warner Medal*

CLAYTON H. BARNARD
*Melville Prize Medal*

JOHN D. STANITZ
*Junior Award*

J. KENNETH SALISBURY
*Pi Tau Sigma Richards Memorial Award*

his parents in 1916 and continued his education there. After receiving an electrical-engineering degree at Delft in 1924, he came to the United States and was employed by the (then) Westinghouse Electric and Manufacturing Co. Upon completion of its student course he was assigned to the research laboratories, where he continued until 1932. Participation in the combined educational program between the company and the University of Pittsburgh brought him a PhD degree in 1929. In 1930–1931 he studied fluid mechanics under Professor Prandtl at the University of Goettingen. Also in 1930 he became a citizen of the United States.

In 1932 he was asked to join the faculty of the Harvard Engineering School, where he remained until he was called to active duty in the USNR. He served first in the Bureau of Ships, later with the U. S. Naval Technical Mission in Europe, and rose to the rank of captain in 1945. Since that time he has been professor of mechanical engineering at the Massachusetts Institute of Technology.

The Pi Tau Sigma Richards Memorial Award was presented to Dr. Den Hartog in 1947.

#### MELVILLE PRIZE FOR ORIGINAL WORK

*Clayton H. Barnard.* A native of Keene, N. H., where he was born in 1914, Clayton Hamlin Barnard received his BS degree in mechanical engineering from the University of New Hampshire in 1935. Additional studies were taken at Northeastern University.

Since graduation Mr. Barnard has been associated with the Bailey Meter Company, Cleveland, Ohio. For several years he was assigned to the Boston office as sales-service engineer,

and in 1945 he was transferred to the main office as application engineer. Since that time he has been working on the application of instruments and controls for process industries and naval vessels.

He is the author of several published technical papers dealing with measurement and control, and has been granted several patents in that field. His paper on "Gas Analyzers for Better Combustion," for which he has been awarded the 1951 Melville Medal, was presented at the Fuels Division Meeting in Cleveland, October, 1950.

Mr. Barnard transferred from a student to a junior member of the ASME following his graduation and became a member in 1950. He is also a member of the Cleveland Engineering Society, the Instrument Society of America, and the America Society of Naval Engineers.

#### JUNIOR AWARD

*John Daniel Stanitz* was born in Youngstown, Ohio, on May 13, 1920. He received his MS degree in mechanical engineering from the Massachusetts Institute of Technology in 1943 and is now completing the requirements for an ScD degree.

Following his graduation, Mr. Stanitz began work at the Lewis Flight Propulsion Laboratory of the National Advisory Committee for Aeronautics, in Cleveland. He has been head, successively, of the cylinder charging section, the turbopropeller performance section, and the applied compressor and turbine analysis section. At present he is engaged in research on aerodynamic problems of compressors and turbines.

In addition to his NACA reports, Mr. Stanitz has written several papers for the technical press, including one entitled "Some Theoretical Aerodynamic Investigations of Impellers in Radial- and Mixed-Flow Centrifugal Compressors," which was presented at the Fall Meeting of the ASME in Minneapolis in September, 1951. The paper for which he is receiving the Junior Award is "Analysis of the Exhaust Process in Four-Stroke Reciprocating Engines," and it was presented in June, 1950, at the Oil and Gas Power Division Meeting in Baltimore, Md. It was published in the ASME Transactions.

#### PI TAU SIGMA RICHARDS MEMORIAL AWARD

*J. Kenneth Salisbury*, who was born in Youngstown, Ohio, in 1909, received a BSE degree in mechanical engineering from the University of Michigan in 1929. After obtaining his MS (ME) there the following year he began work with the General Electric Company. His early duties included testing steam turbines and work on the design and construction of mercury-vapor power plants. He was assigned to the turbine engineering department in 1933, transferred to the general engineering and consulting laboratory in 1946, and appointed division engineer of the thermal power systems division of the laboratory a year later. He has contributed to the design of steam turbines for both central-station and marine use, and particularly to the design of naval propulsion equipment for the U. S. Navy. In his present position, which entails design, engineering, manufacturing, and financial responsibilities, he has directed a great deal of constructive work on gas turbines and associated apparatus.

Mr. Salisbury's writings include many papers and discussions in the technical press, contributions to the "Britannica Year Book," and two books, "Heat Engineering and Thermodynamics," and "Steam Turbines and Their Cycles." He was editor-in-chief of the 1950 Power volume of "Kent's Mechanical Engineers' handbook." A paper on steam-turbine regenerative cycles won him the ASME Melville Medal in 1942.

During World War II, in addition to his regular G.E. duties, he taught at Union College under the ESMWT program.

A member of the ASME since 1942 (he was a student member at the University of Michigan and transferred to junior membership in 1930), Mr. Salisbury has rendered valuable committee service in the Oil and Gas Power, Gas Turbine Power, and Aviation Divisions, and also in the Schenectady Section. He is a member of Sigma Xi, Pi Tau Sigma, Phi Kappa Phi, and Iota Alpha honorary societies.

#### PI TAU SIGMA GOLD AWARD

*Warren M. Rohsenow*. One of the youngest men on the mechanical engineering faculty at the Massachusetts Institute of Technology, Warren Max Rohsenow has made an impressive record both in teaching and in research work since his graduation from Northwestern University ten years ago.

He was born in Chicago in 1921, and after taking his BSME degree he continued his studies at Yale University where he received an ME degree in 1943 and a DE the following year. While working for these degrees he served for two years as laboratory assistant in mechanical engineering and then as instructor. He also taught at the New Haven YMCA College.

In 1943-1944 he was active on the Columbia University NDRC project on torpedoes and then until 1946 he served as lieutenant (j.g.) in the USNR, on active duty at the U. S. Naval Engineering Experiment Station at Annapolis, working with the gas-turbine group on performance and test of gas turbines. He is still a consultant in this work.

Dr. Rohsenow has engaged in consulting practice in heat transfer, fluid flow, and gas turbines for a number of industrial companies and government agencies and is currently active as a consultant for the Carbide and Carbon Chemicals Corporation at Oak Ridge, Tenn.

He has made important contributions to the development of methods of teaching and to laboratory activities at M.I.T. He has created a very worth-while graduate subject, advanced heat transfer, and has supervised a long list of theses on that subject. He has exerted a beneficial influence in the department of mechanical engineering because of his interest in students and younger staff members.

A junior member of the ASME since 1941, Dr. Rohsenow is taking part in committee service in the Heat Transfer Division of the Society.

#### UNDERGRADUATE STUDENT AWARD

*Philip Levine*. A paper entitled "An Experimental Analysis of Flame Propagation in Cylindrical Tubes," has won the Undergraduate Student Award for Philip Levine.

Mr. Levine was graduated in June of this year from the University of Connecticut, receiving a BS degree. He became a student member in 1949 and has transferred to the grade of junior member since his graduation.

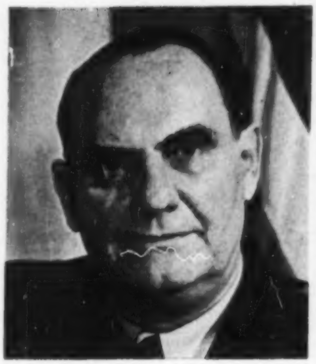
During his college career he was active in the ASME Student Branch, serving as secretary as well as member of several committees. Mr. Levine is a member of Tau Beta Pi, Pi Tau Sigma, and Sigma Xi, national honorary societies, and Gamma Chi Epsilon, local honorary organization. During his senior year he was editor-in-chief of the *Connecticut Engineer*, student engineering magazine.

He was also a member of Tau Epsilon Phi, social fraternity, and represented the fraternity in intramural sports. He worked his way through college in such part-time jobs as truck driver, stevedore, bookkeeper, clerk, and milkman.

Mr. Levine was born in Hartford, Conn., on Nov. 23, 1926, and grew up in Bloomfield, Conn. He is now employed as a research intern for the National Advisory Committee for Aeronautics, Langley Field, Va., and resides in Newport News.

The Undergraduate Student Award for 1951 was presented to

# Recipients of Medals and Awards



WILLIAM L. BATT
*Hoover Medal*

E. G. BAILEY
*John Fritz Medal*

THOMAS R. JONES
*Gantt Medal Award*

PHILIP LEVINE
*Undergraduate Student Award*

WARREN M. ROHSENOW
*Pi Tau Sigma Gold Award*

Mr. Levine at the Members and Students Luncheon, held in the Carolina Room, Chalfonte Hotel, Thursday, Nov. 29, 1951.

JOHN FRITZ MEDAL FOR 1952

*E. G. Bailey.* The award of the John Fritz Medal to E. G. Bailey follows many other honors bestowed upon him for his achievements in steam and combustion engineering and his leadership in professional societies. These honors include the Longstreth Medal of The Franklin Institute (1930); the Lamme Medal of The Ohio State University (1936); the Percy Nicholls Award, and the ASME Medal (1942); and several honorary degrees: Doctor of Engineering from Lehigh University and Ohio State, and Doctor of Science from Lafayette College.

Applications of his numerous inventions by The Babcock & Wilcox Co. and the Bailey Meter Company have conserved coal through efficient combustion, thereby lowering power-production costs. Among the inventions and developments evidencing his creative engineering ability are the boiler meter and the water-cooled furnace-wall construction bearing his name; furnace designs and firing methods for the utilization of pulverized coal; and his system of combustion control in boiler furnaces.

Born in Ohio in 1880, Dr. Bailey became interested in coal while attending The Ohio State University. Following his graduation with an ME degree in 1903, he was successively associated with the Consolidation Coal Company, Fairmont, W. Va., Arthur D. Little, Boston, Mass., and the Fuel Testing Company of that city, in which he was a partner. With this background of experience in the testing and combustion of coal he then founded the Bailey Meter Company, Cleveland, Ohio,

which he served as president until 1944 and of whose Board he has since been chairman. He was president of the Fuller-Lehigh Company from 1926 to 1935 and has been vice-president of the Babcock & Wilcox Co. since 1930.

Throughout his career Dr. Bailey has been interested in engineering education and has exerted an important influence in that field through the American Society for Engineering Education and the Engineers Joint Council, as well as through papers dealing with the curricula and policy of engineering schools. He assisted in the organization and was chairman of the Engineering Manpower Commission of the Engineers Joint Council.

Dr. Bailey has held membership in the ASME since his graduation and has rendered important service through its committees, particularly the Standing Committee on Research. He became a Fellow in 1943 and was president of the Society in 1947-1948. He is an honorary member of The Institution of Mechanical Engineers and a member of the American Institute of Mining and Metallurgical Engineers, Society of Naval Architects and Marine Engineers, and various other technical societies, as well as the Sigma Xi, Tau Beta Pi, and Pi Tau Sigma honorary societies. His many contributions to the technical press, making public the results of his studies and practical research, have been of invaluable benefit to modern civilization.

### GANTT MEDAL AWARD FOR 1951

*Thomas Roy Jones.* In a variety of ways Thomas Roy Jones has shown himself worthy of the Gantt Medal. During his early years as president of American Type Founders, Inc., he reorganized the company and modernized and expanded its manufacturing, finance, and sales activities. The postwar result of his knowledge of management and his unusual vision was Daystrom, Inc., which is the parent organization not only for ATF, but also for companies manufacturing such diversified products as furniture, recording and electronic equipment, plywood, and gunfire control systems and other electronic equipment for military use.

Coupled with his expansion program for the company's economic health has been his development of employer-employee relations which have been adopted by other progressive companies. He is a leading exponent of communicating management thinking to all employees and has devoted much thought and study to the science of human relations as they affect industrial workers and the public as well. As a speaker, he has brought his views before leading business, civic, and industrial groups throughout the country.

Mr. Jones is a trustee, treasurer, and member of the executive committee of the Committee for Economic Development, and chairman of the planning and development council of New Jersey Department of Conservation and Economic Development. He was the first president of the New Jersey State Safety Council and twice re-elected. He is a past-president of the New Jersey Chamber of Commerce and still serves as a director and executive committee member of it. He is a trustee and treasurer of Industrial Relations Counselors, a nonprofit industry-supported organization devoted to studying better practical relations in industry. He is a former director of the American Management Association and former chairman of its executive committee.

Born in Kingman, Kan., in 1890, Mr. Jones received a mechanical-engineering degree from the University of Kansas in 1913 and took postgraduate work at the Harvard Graduate School of Business Administration in 1916-1917. Prior to his connection with the American Type Founders he was assistant general manager of the Cincinnati Milling Machine Company, and vice-president and general manager of the Harris-Seybold-Potter Company, Cleveland, Ohio. During World War I he served in the army, advancing to the rank of captain on the general staff. In World War II he was active on the War Labor Board and War Production Board.

### HOOVER MEDAL FOR 1951

*William L. Batt.* To the growing list of distinguished public services rendered by William Loren Batt is that of head of the Economic Cooperation Administration for Great Britain. This appointment, along with that of the United States member of the North Atlantic Defense Production Board, was made in November, 1950. His offices are in London.

His administrative ability, represented in private industry by SKF Industries, Inc., of Philadelphia, Pa., was first applied to Federal government service on the Business Advisory Council of the Department of Commerce, of which he became chairman in the early days of World War II. Subsequent appointments were those of deputy commissioner, Industrial Materials Division, Advisory Commission to the Council of National Defense; deputy director, Production Division, Office of Production Management; member of Harriman Mission to Moscow in 1941, with temporary rank of Minister Plenipotentiary and Extraordinary; director of materials, Office of Production Management; and vice-president, War Production Board.

Dr. Batt was born in Salem, Ind., in 1885. Not long after his graduation in mechanical engineering from Purdue University in 1907, he became associated with the Hess-Bright Manufacturing Company, Philadelphia, Pa., manufacturers of antifriction bearings. In 1917 this company consolidated with others to form SKF Industries, with Dr. Batt as vice-president. He became its president in 1922 and continued in that position until his retirement in 1950.

Among the honors heretofore conferred upon Dr. Batt are the Order of Vasa (1926) and Royal Order of the North Star (1933) by King Gustav V for his activity in promoting commercial relations with Sweden; the Gantt Medal (1940) in recognition of his leadership in industrial management; the Edward Bok Award (1943) for his war effort; and inclusion in the Canadian honors list (1946) when he was made an honorary companion of the Order of St. Michael and St. George by King George VI. Honorary membership in The Institution of Mechanical Engineers and the degree of DE from Purdue University are also his.

To the ASME, in which he has held membership since 1911, he has given generously of his time in committee service and in the offices of manager, vice-president, and president (1936). He was elected a Fellow in 1938 and an honorary member in 1942. He is also a member of the Society of Automotive Engineers and Tau Beta Pi fraternity.

Dr. Batt has been a leader in international activities in management and standardization, written many articles and delivered numerous addresses of broad significance, and advanced his profession through every means possible to him.

The John Fritz, the Gantt, and the Hoover Medals were awarded at the Honors Luncheon, held in the Carolina Room, Chalfonte Hotel, Wednesday, Nov. 28, 1951.

# ASME 1951 ANNUAL MEETING PREPRINTS

*Pamphlet copies of the following ASME Annual Meeting Papers are available from ASME Order Department, 29 West 39th Street, New York 18, N. Y.*
*See page 9 for details*

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| 51—A-1 | On Symmetrical Strain in Solids of Revolution in Spherical Co-Ordinates, by CHIH-BING LING and KUO-LIANG YANG |
| 51—A-2 | A New Method of Calculation of Reheat Factors for Turbines and Compressors, by JOSEPH KAYE and K. R. WADLEIGH |
| 51—A-3 | The Safety Factor of an Elastic-Plastic Body in Plane Strain, by D. C. DRUCKER, H. J. GREENBERG, and W. PRAGER |
| 51—A-5 | The Theory of Plasticity Applied to a Problem of Machining, by E. H. LEE and B. W. SHAFFER |
| 51—A-6 | A Statistical Distribution Function of Wide Applicability, by WALODDI WEIBULL |
| 51—A-7 | The Calculated Performance of Dynamically Loaded Sleeve Bearings—III, by J. T. BURWELL |
| 51—A-8 | The Theoretical Analysis of Metal-Forming Problems in Plane Strain, by E. H. LEE |
| 51—A-9 | On the Direction of Fatigue Cracks in Polycrystalline Ingot Iron, by F. A. McCLINTOCK |
| 51—A-10 | On the Axisymmetric Problem of the Theory of Elasticity for an Infinite Region Containing Two Spherical Cavities, by E. STERNBERG and M. A. SADOWSKY |
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| 51—A-13 | Supersonic Flow With Variable Specific Heat, by F. P. DURHAM |
| 51—A-14 | Torsion of Curved Beams of Rectangular Cross Section, by H. L. LANGHAAR |
| 51—A-15 | The Time Required for Constant-Volume Combustion, by A. S. CAMPBELL |
| 51—A-16 | Approximate Approach for Torsion Problem of a Shaft With a Circumferential Notch, by H. OKUBO |
| 51—A-17 | Bending of a Cylindrically Aeolotropic Circular Plate With Eccentric Load, by A. M. SEN GUPTA |
| 51—A-18 | Bending of a Circular Beam Resting on an Elastic Foundation, by ENRICO VOLTERRA |
| 51—A-19 | A Variational Principle for the Mesh-Type Analysis of a Mechanical System, by R. A. TOUPIN |
| 51—A-23 | A Contribution to the Theory of the Development and Stability of Detonation in Gases, by A. K. OPPENHEIM |
| 51—A-24 | The Bending of Uniformly Loaded Sectorial Plates With Clamped Edges, by H. D. CONWAY and M. K. HUANG |
| 51—A-25 | Partially Plastic Thick-Walled Cylinder Theory, by M. C. STEELE |
| 51—A-27 | An Electrical Method for Determining Journal-Bearing Characteristics, by D. S. CARTER |
| 51—A-28 | Several Approximate Analyses of the Bending of a Rectangular Cantilever Plate by Uniform Normal Pressure, by W. A. NASH |
| 51—A-29(*a*) | Measurement of Recovery Factors and Friction Coefficients for Supersonic Flow of Air in a Tube,, 1—Apparatus, Data, and Results Based on a Simple One-Dimensional Flow Model, by J. KAYE, J. H. KEENAN, K. K. KLINGENSMITH, G. M. KETCHUM and T. Y. TOONG |
| 51—A-29(*b*) | Measurement of Recovery Factors and Friction Coefficients for Supersonic Flow of Air in a Tube, 2—Results Based on a Two-Dimensional Flow Model for Entrance Region, by J. KAYE, T. Y. TOONG, and R. H. SHOULBERG |
| 51—A-30 | An Alternative Formulation of the Laws of Mechanics, by H. M. TRENT |
| 51—A-31 | Linear Bending Theory of Isotropic Sandwich Plates by an Order of Magnitude Analysis, by GEORGE GERARD |
| 51—A-32 | Gas Cooling of a Porous Heat Source, by LEON GREEN, JR. |
| 51—A-38 | Heat-Exchanger Tube-Sheet Design—2 Fixed Tube Sheets, by K. A. GARDNER |
| | AVIATION |
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| 51—A-66 | Operating Characteristics of Cylindrical Roller Bearings at High Speeds, by E. F. MACKS, Z. N. NEMETH, and W. J. ANDERSON |
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| 51—A-86 | Air Freight-Handling Technique at Kelly Air Force Base, Texas, by I. E. CAMPBELL |
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| 51—A-79 | An Investigation of Electromagnetic Flowmeters, by H. G. ELROD, JR., and R. R. FOUSE |
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| 51—A-20 | Thermodynamics of Gasification of Coal With Oxygen and Steam, by WAYNE C. EDMISTER, HARRY PERRY, R. C. COREY, and M. A. ELLIOTT |

# COMMENTS ON PAPERS

*Including Letters From Readers on Miscellaneous Subjects*

## Shotpeening of Gears

Comment by H. J. Bates[1]

We agree thoroughly with the views expressed in the paper[2] and feel that not enough is being done in the way of incorporating shotpeening into original design. This paper should contribute to a movement in that direction. The estimated savings are, we believe, conservative since only savings in material costs are figured. There would also be reductions in processing costs, bearing costs, housing costs, and several other indirect factors depending upon the particular application.

Referring to the statement, "The gears are then hardened, shotpeened, and ground," our first thought was that it would be inadvisable to shotpeen and then grind the surface. Reading further, the reasoning behind this proposal is clear, but it raises a question: Since ground surfaces are apt to be in tension what would be the effect, in the case of a carburized and hardened gear, of a ground surface which was in tension being immediately adjacent to a shotpeened surface which would probably be in compression? There would be a very marked change in stress pattern not only in magnitude but also in direction in a relatively short distance.

Comment by D. W. Dudley[3]

The author has made a keen analysis of the factors involved in designing gears. He shows how the designer must consider tooth strength, tooth-pitting resistance, and resistance to scoring, to obtain a balanced design. An improvement in one factor changes the balance and permits the designer to change proportions so that the ability of the gear to resist all three types of failure is improved.

In the writer's opinion, the paper is particularly valuable for its insight into gear-design complications. The procedure which the author proposes for designing gears is appropriate for certain types of gears, but not entirely adequate for others. Probably the best way to understand the meaning of his method of design—and its possible limitations—is to consider a sample problem.

Suppose a 10-pitch set of gears for 4 to 1 ratio were designed to be at the limit of tooth strength, and scoring at 10,000,000 cycles with the teeth nonpeened. According to Fig. 2 of the paper, shotpeening would increase the strength about 40 per cent. Since root stress is almost proportional to pitch, the pinion could be made 14 pitch, shotpeened, and maintain equal strength to the original 10 pitch. This would not help, though, since we want to carry more load.

Suppose we make the tooth 12-pitch shotpeened. Strength would then be increased 16 per cent. (Increase = (10/12) $\times$ 140 per cent.) The ability of the gear to withstand scoring is roughly proportional to the 4th power of the pitch when other things remain constant. A change to 12 pitch would increase the load capacity 100 per cent from the tooth-scoring standpoint!

To strike a balance, the pitch change would have to be made about 10.7. This would increase scoring resistance about 31 per cent and—with shotpeening—the increase in tooth strength is about 30 per cent. The load could be increased 30 per cent with these changes, providing the teeth originally had had some extra capacity to withstand pitting.

If these gears were intended for some high-speed truck or locomotive application, the foregoing procedure might be followed. However, if they were for aircraft, the designer probably would not solve the problem in the manner indicated. The PVT constant of 1,500,000 is based on unmodified tooth profiles. With proper profile modification, the critical PVT number can be increased greatly. This enables the designer, in most cases, to balance tooth strength against tooth pitting without concern about the PVT factor.

To increase tooth strength, the designer is apt to go to "unground root fillets," larger fillet radii, or special materials and heat-treatments. In the very high-speed modern aircraft, the rough finish of shot-blasting cannot often be tolerated on the working surfaces. (Very thin oils are used.) If the tooth is ground or lapped after shot-blasting, there is danger that the tooth will break just above the point where the shot-blasting ends. In some designs and materials, the teeth tend to break quite high on the flank.

The paper shows how shotpeening is a major factor in the design of certain gears. In other kinds of gears, many things beyond those covered in his paper must be considered.

Author's Closure

The author is sincerely grateful to Mr. Bates and to Mr. Dudley for their excellent comments.

Mr. Bates's question on the effect of the transition from compressive stress in the peened area to a possible tension stress in the ground area is well taken. While this procedure is being used successfully in production, there is a possibility in particular cases that the stress due to the applied load may not be appreciably less at a point on the tooth profile than that at the fillet. Such a condition is apt to occur in a gear with a large number of teeth and a high-pressure angle.

For example, in the case of a rack tooth with a high-pressure angle, the applied stress as determined by the Lewis method employing a uniform-strength parabola may be a maximum in the tooth profile rather than in the fillet, neglecting stress concentration. However, it has been the author's experience that in the majority of gears, the maximum applied stress is likely to be located in the fillet and would be considerably less in the region of the profile, except in cases similar to those just mentioned.

In any case, when dealing with gears having a large number of teeth and a high-pressure angle, it is desirable to check the position of maximum stress, as well as the stress at a point higher on the tooth. If the stress in the fillet is not appreciably greater than that in the region of the active profile, it would be undesirable to grind the profile after peening.

[1] Superintendent, Metallurgy and Inspection, Fairfield Manufacturing Company, Lafayette, Ind.

[2] "Shotpeening as a Factor in the Design of Gears," by J. C. Straub, Mechanical Engineering, vol. 73, July, 1951, pp. 565–569.

[3] Gear Engineering Division, General Electric Company, West Lynn, Mass. Jun. ASME.

Mr. Dudley also mentions the possibility of tooth breakage in the profile in cases where the gears are lapped after peening. It is the author's belief that this tendency would be much less than in the case of grinding, because of the slight amount of material removed in lapping. With the possible exception of extremely fine pitch gears, the desirable depth of the compressively stressed layer in the peened surface is several thousands of an inch, and therefore much of the compressive stress may remain after lapping, unless the lapping is quite severe.

The author is in complete agreement with Mr. Dudley in that with properly modified tooth profiles, considerably greater p-v-T values can be used. It might be well to mention, however, that there are instances in which a greatly reduced p-v-T value may be obtained by selecting addendums advantageously. Having thus minimized scoring tendencies, if profile modification is still necessary, it would be required to a lesser extent.

Mr. Dudley's comments nicely emphasize the fact that shotpeening, in design, like any other process, should be used with proper consideration for the other design factors involved.

JOHN C. STRAUB.[4]

[4] Chief Research Engineer, American Wheelabrator & Equipment Corporation, Mishawaka, Ind.

# Promoting Ethics in Government

TO THE EDITOR:

In an editorial, "A Job for Engineering Societies," that appeared in the October, 1951, number of *Product Engineering*, G. F. Nordenholdt calls upon engineers to do something about minimizing "graft, corruption, and other forms of dishonesty in government."

During my first six years at the University I had much to do with the negotiation and supervision of state contracts. I found that by the adoption of an uncompromising attitude on the subject I was able to discourage unethical practices on the part of contractors.

Since then I have found that my students, who are very frank in discussing these matters, expect such unethical practices as a matter of course. Therefore, for the past 21 years, I have made it a regular practice to inject into my industrial engineering course, discussions regarding the engineer's civic and social responsibilities.

I know that we have in our Society an actively functioning committee which has even sponsored radio broadcasts on a national network. There is still much public apathy to be overcome, and I believe that each of us has a duty to perform.

My idea has been to work through my students. Others of us may work through our employees or our associates. However we do it, this is a matter of vital importance.

Though this latter is also vitally important, it will avail us little to explain the advantages inherent in our economic system if we condone or ignore the malodorous situation in Washington. If nothing is done about it, the free-enterprise system on which we engineers depend for work opportunity, will go by default.

We need to follow the precepts given by Doctor Wickenden in his great address "The Second Mile." Technical competence is not enough.

Fortunately, we can do this on a nonpartisan basis, as there are men of proved integrity in both parties. In my 35 years of membership I have learned to expect much of the leadership of The American Society of Mechanical Engineers.

CARROLL D. BILLMYER.[5]

## Professional Focus

TO THE EDITOR:

Let's for a few minutes turn around and look at education today through the student's eyes—his progress as a human being—for the central belief of the West is that the human individual is the top value in the world.

Let's assume a perfect teaching result in science, general engineering, economics, and English. The colleges can never reach 100 per cent, but the value of effort falls off rapidly beyond a certain point. The focus has been scientific and technical, and when he enters the world at graduation the student finds the focus is nontechnical. As a result he is confused. He doesn't seem to have common sense. To meet this defect some of us in America think he needs the *professional* focus; that is, he needs to understand his responsibilities to society, in which his work as an engineer is still his central contribution, but not his sole contact.

This doesn't necessarily call for a course in sociology, one in history, one in psychology, and one in government. There isn't time for them all. And they too are taught by specialists—just as narrow as engineering specialists.

Some of us think the situation needs only a friendly opportunity to talk to older men in their own field—men whom they trust—the faculty in their chosen major subject; to talk about the relationship of the engineer to the corporation, to the community, to society. The faculty don't digress to discuss these subjects in engineering classes—and shouldn't. Engineering professors aren't experts in this field, of course, but I would trust their views far above the influences of radio, movies, and newspapers which will educate the young man in the ways of the world, in the meaning of life, if the faculty doesn't.

These professional conferences don't give dogmatic and authoritative answers, but they dispel blind spots and deformities in the student's outlook. He begins to see a clear and worthy view of life as a professional man. He begins to form his own philosophy of life. Unity of outlook, combining both his technical and his humanistic studies, begins to take shape. His world begins to make sense, to have perspective. It comes into focus—into the professional focus.

This is nothing new. Oxford and Cambridge have done it for centuries under the system where the student reports to a tutor once or twice a week and both sit before the fire and smoke a pipe.

At Lehigh we call them Professional Development Conferences, and they are held once a week in the senior year in metallurgy. When a big question comes up like labor-management relations we refer them to a copy of *Fortune* or a chapter in "Middletown," and follow their book reports with open discussion.

When communism versus democracy comes up we refer them to a speech by Charles Malik or General Eisenhower, or a biography of Herbert Hoover. Later we invite in industrial leaders, politicians, scientists, and physicians to lead discussions. Thus engineering rediscovers the *man* but doesn't lose sight of the *specialist* in doing so.

What do you, graduates of other colleges, think of these conferences as a part of the education of an engineer who is also a man?

GILBERT E. DOAN.[6]

[5] Associate Professor of Mechanical Engineering, University of Rhode Island, Kingston, R. I. Mem. ASME.

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# REVIEWS OF BOOKS

*And Notes on Books Received in the Engineering Societies Library*

## How to Chart Time-Study Data

How to Chart Timestudy Data. By Phil Carroll. McGraw-Hill Book Company, Inc., New York, N. Y.; Toronto, Ont., Can.; London, England, 1950. Cloth, $5^3/_4 \times 9$ in., 96 figs., index, xii and 323 pp., $5.

Reviewed by L. E. Davis[1]

THE author sets for himself the limited goal of discussing the need for and methods of charting time-study data and he resolutely adheres to this theme. Whether or not such a limited subject can be adequately discussed depends upon the reader's concepts of time study. Time study is viewed by some as a work or productivity measurement system and by others as a series of mechanistic steps resulting in data containing the desired properties of establishing standards of performance. The major shortcoming of the book is that the material is not presented in the context of a work-measurement system. However a contribution is made in the bringing together of the methods of presentation of time-study standard data.

The first third of the book is devoted to establishing the need for production standards, both direct and indirect, and for wage incentives based upon them. Included in the discussion are causes that the author recognizes which bring about faulty standards and improper incentives. The fundamental questions of the reliability or consistency and the validity or accuracy of work standards are overlooked, which raises doubts as to the reality of the author's impugning against poor practices.

The major theme of the book is that proper presentation of time-study standard data will help reduce the cost of application. Only charting for standard-data purposes is discussed. One of the basic defects in the standard-data approach,[2] that of the use of nonstandardized or nonuniversal elements, is not discussed. Neither is its contribution to poor and costly standard data considered.

The remaining two thirds of the book is devoted to the mechanics of the analysis and presentation of data. Good suggestions are given for the isolation of dimensions or parameters causing variations in time for variable elements. A detailed discussion of six forms of data presentation from simple curves through multivariable charts is well done. So is the section on forms design of multivariable charts. Toward the end the author indicates, and soundly so, the need to express data numerically in tabular form as one that will result in fewer errors of application and greater ease of explanation.

The major accomplishment of the book is the restating of existing applicable techniques of data presentation in the context of time study and the bringing together of the material as a handy reference. This is its contribution to time study.

[1] Assistant Professor of Mechanical Engineering, University of California, Berkeley, Calif. Mem. ASME.

[2] "A Proposal for Improvement of Time Study," by L. E. Davis, Mechanical Engineering, May, 1949, vol. 71, p. 399.

## Hydraulic Transients

Hydraulic Transients. By George R. Rich. Engineering Societies' Monographs Series. McGraw-Hill Book Company, Inc., New York, N. Y.; Toronto, Ont., Can.; London, England, 1951. Cloth, $5^3/_4 \times 9$ in., figs., tables, bibliography, index, x and 260 pp., $7.

Reviewed by S. Logan Kerr[3]

FOR the last 30 years or more there have been constant additions to engineering knowledge on hydraulic transients, but for the most part these have been through the medium of papers presented before various engineering societies and published in a number of different journals. It remained for George Rich to assemble and correlate this information and turn it into a most useful book.

The arithmetic integration process for investigating hydraulic transients has long been an elegant tool where involved equations were needed to solve complex problems.

Successfully exploited by the late Raymond D. Johnson in his treatises on water-hammer and surge-tank design, and further developed by Norman R. Gibson for computing pressure changes in penstocks for slow closures, the mathematical procedure has been used only by a limited group of engineers in this field. Its application has, however, been extended to a number of other problems including the speed regulation of hydraulic turbines.

The author has divided his treatise into nine chapters, the first dealing with water hammer in conduits in which he utilizes arithmetic integration to solve the well-proved elastic-wave-theory formulas. He also reproduces a number of useful charts prepared by Allievi and others, for computing water-hammer pressures based on uniform cutting off of flow.

It would have been well if the author had referred to the uniform rate of cutting off flow rather than uniform valve operation which does not in practical cases reduce flow uniformly with respect to time.

The chapter on turbine speed regulation is of interest as well as the chapter on stability of governing. In this latter chapter there are many interesting charts which have not previously been available in English, but were developed by Daniel Gaden in Switzerland and published in both French and German.

The chapter on water-hammer pressures in pump discharge lines summarizes a number of the engineering articles and emphasizes the need for a more general knowledge of the complete characteristics of centrifugal pumps.

The two chapters dealing with surge tanks are the most comprehensive discussions of this problem appearing in the English language and show the effectiveness of either the differential type or the restricted orifice type in controlling surges.

The chapter on navigation locks is of considerable interest and presents much information that was not previously available in useful form.

The solution of the problem of surges in power canals is derived largely from articles prepared some years ago by Ray-

[3] Consulting Engineer, Philadelphia, Pa. Mem. ASME. Chairman, ASME Committee on Water Hammer.

mond D. Johnson, but is presented in simple, understandable form and is supplemented by other data to include canals influenced by the tides.

The final chapter discusses all too briefly the graphical method of water-hammer analysis. As this method can reduce substantially the amount of calculations necessary for the solution of many problems of hydraulic transients, it should have had greater emphasis.

One of the strong features of this book is the inclusion of complete computations for practical problems in this field. Many of the technical treatises previously published have presented the theory and derived complex equations, but have left the reader without a practical solution of any particular problem or have merely showed the results and have omitted the step-by-step calculations so essential to understanding transient phenomena.

The author has drawn from his broad experience to give detailed numerical solutions for each phase of hydraulic transients and in so doing has made his book far more useful to the engineering profession.

A careful study of many of the figures reproduced from other sources indicates that they have been attributed to much later references and to other authors than as originally published. This applies particularly to the Allievi charts, figures 1-20 to 1-22 inclusive, as these were contained in Lorenzo Allievi's treatises and in the translation of 1925 into English by Halmos and have been reproduced many times since. This same comment applies to other charts and illustrations, as, for example, figs. 1-9 to 1-12 which were a part of the ASME Symposium of 1933 or included as figures in the Strowger and Kerr paper of 1926.

Additional references at the end of each chapter would also have improved the usefulness of the book as there are numerous other contributions to water-hammer theory not cited in this book that would be helpful to engineers and research students.

Engineers dealing with hydraulic problems will find this book a most valuable consolidation of data. As a textbook for students of hydraulics, it is a great advance over anything previously published in English.

### *Library Services*

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

## Books Received in Library

ADVANCED DYNAMICS. Two volumes. By E. H. Smart. Macmillan Company, New York, N. Y., and London, England, 1951. Vol. 1, 419 pp.; Vol. 2, 420 pp. Linen, $5^3/_4 \times 8^3/_4$ in., diagrams, tables, $12 a set. Vol. 1, Dynamics of a Particle, gives a full discussion of rectilinear motion with acceleration directed toward and away from a fixed point, oscillating particles, simple harmonic motion with unresisted and damped vibration, and impulsive forces applied to problems of impact. Vol. 2, Dynamics of a Solid Body, provides a full analysis of d'Alembert's principle and the equations of motion in two and three dimensions, Lagrange's equations and generalized co-ordinates, the motion of a top, Hamilton's equations, and general theorems on impulses.

AIR CONDITIONING IN SUMMER AND WINTER. By R. E. Holmes. Second edition. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Cloth, $6 \times 9^1/_2$ in., 352 pp., illus., diagrams, charts, tables, $5.75. An elementary but comprehensive treatment of the science of air conditioning. Intended for those who wish to work in that field, the book presents such information as will give an understanding of the practical problems of designing and installing air-conditioning apparatus and of the principles and methods by which these problems are worked out. New material has been added in this edition on heat pumps, adsorption systems, water chillers, compressors, panel-heating systems, packaged air conditioners, dehumidifiers, and so on.

AMERICAN SOCIETY FOR METALS, Transactions, vol. 43, 1951. Published by the American Society for Metals, Cleveland, Ohio. Cloth, $6 \times 9$ in., 1245 pp., plus index, illus. diagrams, charts, tables, $10. Fifty papers, occupying some 1200 pages, are reproduced in this current annual volume. The subject matter covers a considerable range: ferrous and nonferrous metallurgy and metallography; plating and metal coatings; working, shaping, and heat-treating; high-temperature alloys and problems; metal testing; and the effect of various conditions on the properties of metals and alloys. Single papers deal with the structure of permanent magnet alloys, with iron-ore smelting, and with the powder metallurgy of beryllium.

ANNUAL REPORT ON THE PROGRESS OF RUBBER TECHNOLOGY, Vol. 14, 1950. Edited by T. J. Drakeley, published by W. Heffer & Sons Ltd., Cambridge, England, for the Institution of the Rubber Industry, London, England, 1951. Linen, $7^1/_4 \times 10$ in., 114 pp., charts, tables, £1, 1s. Beginning with a historical and statistical review, this report proceeds to deal briefly with the following: planting and production of raw rubber and related products; physics and chemistry of raw rubber and rubberlike substances; synthetic rubber; manufactured rubber products such as tires, cables and electrical insulation, mechanical rubber goods, textile-rubber composites, and cellular rubber, machinery and appliances. There are a subject index and an author index to articles cited.

APPLIED MECHANICS FOR ENGINEERS. By Sir Charles Inglis. Cambridge University Press, American Branch, New York, N. Y., 1951. Linen, $7 \times 10$ in., 404 pp., diagrams, charts, tables, $7.50. This comprehensive textbook begins with the fundamental principles of rigid-body statics and the use of graphical methods in problems. The eighteen succeeding chapters cover taut wires and catenaries, framework stresses and deformations, friction, kinematics, harmonic and circular motions, moments of inertia and momentum, the principle of energy, gyroscopic principles and applications, and a variety of aspects of the vibration problem.

AUTOMATIC FEEDBACK CONTROL. By W. R. Ahrendt and J. F. Taplin. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Cloth, $6^1/_4 \times 9^1/_4$ in., 412 pp., illus., diagrams, charts, tables, $7.50. The material in this new text on the analysis and design of automatic-feedback-control systems is divided into two parts: Discussion of the theory of automatic control, and a detailed treatment of the types of problems encountered in industry. Examples of the various classes of instruments are presented, showing both functional and constructional requirements. The author covers the field of servomechanisms, speed governors, and of temperature, pressure, flow, and liquid-level controls. Discontinuities and linearities are studied in considerable detail.

DIESEL ENGINE CATALOG, Vol. 16, 1951. Rex W. Wadman, publisher; published and distributed by Diesel Engines, Inc., 816 N. La Cienega Boulevard, Los Angeles 46, Calif. Fabrikoid, $10^1/_2 \times 13^3/_4$ in., 408 pp., illus., diagrams, charts, tables, $10. Presents detailed descriptions of American Diesel engines, equipment, and accessories. All types are covered, including two and four-cycle and dual fuel, for stationary, automotive, or marine use. A classified buyers' guide of engines and accessories is provided. As usual the new edition has been revised to include new designs developed during the intervening twelve months.

DISPLACEMENT PUMPS AND MOTORS. By R. Hadekel. Sir Isaac Pitman & Sons, Ltd., London, England, 1951. Cloth, $5^1/_2 \times 8^3/_4$ in., 172 pp., diagrams, 25s. Following a general discussion and classification of displacement machines, the book proceeds to deal in detail with the characteristics and operation of the major types as follows: piston machines; gear machines; vane machines; spherical and skew mechanisms; variable capacity machines; hand pumps and foot pumps. Constructional problems of gear and vane machines are considered in a separate chapter.

EINFÜHRUNG IN DIE THEORETISCHE GASDYNAMIK. By R. Sauer. Second edition. Springer-Verlag, Berlin, Göttingen, Heidelberg, Germany, 1951. Paper $6 \times 9$ in., 174 pp., illus., diagrams, charts, tables, 16.50 Dm. Written for engineers, this book provides a mathematical treatment of steady flow of fluids moving with such high velocities that they no longer have a uniform viscosity. In addition to nonturbulent flow conditions, the characteristics of turbulent supersonic flow are presented as well as three-dimensional problems which pertain to supersonic flow around moving bodies and wings.

ENGINEERING DESIGN. By J. E. Taylor and J. S. Wrigley. Third edition. Sir Isaac Pitman & Sons, Ltd., London, England, 1951. Cloth, $8^3/_4 \times 11$ in., 137 pp., diagrams, charts, tables, 18s. This book links the fundamental

principles of strength of materials and allied subjects with their application to the actual designing of simple machines or parts of machines. Proofs of fundamental formulas and illustrations of common engineering details are omitted, since they can be found in standard works. The recommendations of the British Standards Institution have been followed in the drawings.

ENGINEERING GRAPHICS. By J. T. Rule and E. F. Watts. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Linen, 6 × 9¼ in., 298 pp., diagrams, charts, tables, $3.75. This text presents the study of engineering drawing in a broader manner than usual. Emphasis is placed on the use of graphical methods for the analysis of engineering problems. Methods of construction of conic sections, roulettes and spirals, graphical scales, empirical and periodic curves, and projective constructions are considered with simple applications to numerical problems. The latter part of the book is devoted to the customary elements of machine drawing which underlie normal drafting-room practice.

GRENZSCHICHT-THEORIE. By H. Schlichting. Verlag G. Braun, Karlsruhe, Germany, 1951. Linen, 6¾ × 9½ in., 483 pp., illus., diagrams, charts, tables, $10.50 or 75s; unbound, $10 or 72s. Based on lectures given at the Technical University of Braunschweig, this book introduces the mathematical and physical background of the problems involved in the motion of viscous fluids. The basic equations of the boundary-layer theory as they are derived from the Navier-Stokes equation are discussed in detail. The theory of the boundary layer is then extended to the laminar and to the turbulent boundary layer with attention given to the problem of the development of turbulence.

HANDBOOK OF MEASUREMENT AND CONTROL. Edited by M. F. Behar and Associates. Instruments Publishing Co., 921 Ridge Ave., Pittsburgh, Pa., 1951. Linen, 8¼ × 11¼ in., 291 pp., illus., diagrams, charts, tables; included in subscription to *Instruments*, $3.00 a year. This handbook is designed to provide users, manufacturers, and students with classifications, operating factors, and typical applications of instruments. The term "instruments" includes all indicating, recording, integrating, controlling, and computing devices used in measurement, inspection, testing, and control applications. Laboratory, scientific, engineering, and industrial instruments are included. Although detailed discussion of physical fundamentals is not attempted, all basic methods and mechanisms are covered including pneumatic, hydraulic electric, and electronic.

INTEGRAL TRANSFORMS IN MATHEMATICAL PHYSICS. (Methuen's Monographs on Physical Subjects.) By C. J. Tranter. John Wiley & Sons, Inc., New York, N. Y.; Methuen & Co., Ltd., London, England, 1951. Linen, 4¼ × 6¾ in., 118 pp., diagrams, charts, tables, $1.50. This book provides an outline of the use of integral transforms in obtaining solutions to problems governed by partial differential equations with assigned boundary and initial conditions. It also shows that a similar technique can be employed whatever the range of integration of the transform. Examples given in the book relate to radial flow of heat, heat conduction, the motion of a very long string, stresses in a long circular cylinder, and heat flow in a cylinder with radiation at the surface.

HEAT AND THERMODYNAMICS. By M. W. Zemansky. Third edition. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Cloth, 6 × 9¼ in., 465 pp., diagrams, charts, tables, $6. This intermediate textbook for students of physics, chemistry, and engineering discusses in the first half the fundamental ideas of heat, ideal gases, reversibility, and entropy. The remaining chapters deal with physical, chemical, and engineering applications in sufficient detail to show how the general principles are applied to specific cases. The book has been considerably revised to conform with recent developments in low-temperature physics, streamline flow, turbulence, and so on.

HOT WORKING OF NON-FERROUS METALS AND ALLOYS. Institute of Metals Monograph and Report Series, No. 9. Institute of Metals, London, England, 1951. Linen, 5½ × 8½ in., 208 pp., illus., diagrams, charts, tables, 15s; $2.50, U. S. A. The monograph consists of eight papers, with discussion, reprinted from the *Journal of the Institute of Metals*, which formed a symposium on the subject. In these papers the metallurgical aspects of hot working, its applications, and problems encountered in its processes are generally discussed. The metals dealt with are aluminum, magnesium, copper, tin, lead, and zinc.

INDUSTRIAL PIPING. By C. T. Littleton; Special Chapter on Estimating, by R. A. Dickson. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada, London, England, 1951. Linen, 6 × 9¼ in., 394 pp., illus., diagrams, charts, tables, $8. This comprehensive text is also designed as a reference book for practicing engineers and piping designers. It discusses the important piping materials; presents data for important flow calculations, pipe-size determination, and the selection of valves and fittings for water, gas, steam, and oil-piping systems. The design procedure for a modern industrial plant is outlined, and a special chapter covers piping-cost estimation.

MATERIALS HANDBOOK. By G. S. Brady. Seventh edition. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Fabrikoid, 6 × 9¼ in., 913 pp., illus., tables, maps, charts, $8.50. This standard reference work gives practical data on approximately 9,000 materials arranged under several hundred major headings. The condensed information gives chief characteristics, sources, comparative data, and uses. There are a detailed 50-page index and a supplementary section giving basic information on weights, measurements, physical-property ranges, definitions, and various useful tables. As with the successive previous editions, additional material and topics have been included to keep the contents up to date.

QUALITY-CONTROL HANDBOOK. Edited by J. M. Juran. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Linen, 6 × 9¼ in., 800 pp., illus., diagrams, charts, tables, $10. The first half of this comprehensive volume covers the economics and specification of quality, how to organize for quality, the acceptance, control, and assurance of quality, statistical methods in the quality function, and forms and records for quality-control procedures. In the second half, applications to specific processes and products are described by specialists in textile production, chemical-process industries, aircraft manufacture, electron tubes, and screw-machine operations. Illustrative examples from actual cases provide practical working information. There are also chapters on the applications of electric accounting machines to quality control and on an improved procedure for sampling inspection of any material.

RUBBER RED BOOK, Directory of the Rubber Industry, Eighth edition, 1951–1952. *Rubber Age*, New York, N. Y. Linen, 6 × 9½ in., 1006 pp., illus., $7.50. This comprehensive directory provides both classified and alphabetical lists of the following: rubber manufacturers in the United States and Canada, suppliers of machinery and equipment, laboratory equipment, accessories and fittings, rubber chemicals, fabrics, natural rubber, and related materials. Scrap and reclaimed rubber are covered. There are also lists of consulting technologists, trade and technical organizations, educational courses in the field, and technical journals, and a Who's Who of the rubber industry.

STANDARD MANUAL ON PIPE WELDING. Heating, Piping, and Air Conditioning Contractors National Association, New York, N. Y., 1951. Linen, 6 × 9¼ in., 506 pp., illus., diagrams, charts, tables, $7.50. Written primarily for the piping contractor, this comprehensive manual contains material of value to the architect and engineer as well. Welding equipment and processes are described, and materials and filler metals are thoroughly covered. Shop organization is discussed, and space is devoted to layout and fabrication details, including templets and jigs. Other topics considered are cost estimating, testing and inspection, selection and training of operators, and the scope of pipe welding. Welding terms and symbols are listed, and necessary tables and formulas are included.

SYMPOSIUM ON METHODS OF MEASURING VISCOSITY AT HIGH RATES OF SHEAR. Special Technical Publication No. 111. American Society for Testing Materials, 1951. Paper, 6 × 9 in., 47 pp., diagrams, charts, tables, $1.35. The purpose of this symposium was to find a suitable method for testing viscosity at high rates of shear of various additives used in lubricants and fluids. The three papers given include the results of investigation of two promising methods.

TABLES OF THE EXPONENTIAL FUNCTION $e^x$. U. S. Bureau of Standards, Applied Mathematics Series No. 14, 1951. Buckram, 8 × 10½ in., 537 pp., tables, $3.25, for sale by Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. Tables of ascending exponentials in following ranges: 0.0000–1.0000 to 18 decimals, 1.0000–2.5000 to 15 decimals, 2.500–5.000 to 15 decimals, and 5.00–10.00 to 12 decimals; descending exponentials 0.0000–2.5000 to 18 decimals; ascending and descending exponentials 0.000000–0.000100 to 18 decimals, 1–100 to 19 significant figures, and $1 \times 10^{-10}$ to $9 \times 10^{-7}$ to 18 decimals; values of $e$ and $1/e$ to 2556 decimals.

THERMODYNAMICS OF IRREVERSIBLE PROCESSES. By S. R. de Groot. Interscience Publishers, New York, N. Y.; North-Holland Publishing Co., Amsterdam, Netherlands, 1951. Linen, 6 × 9 in., 242 pp., diagrams, charts, tables, $4. A review of the thermodynamic aspects of a recently developed macroscopic theory of irreversible processes based substantially on nonequilibrium thermodynamical functions. The first two chapters give an introduction to the various treatments of irreversible processes and an account of the foundations of thermodynamic theory. In the following seven chapters a number of examples covering important applications in physics and chemistry are treated. In conclusions certain general questions are considered from a more advanced point of view.

# ASME BOILER CODE

## Interpretations

THE Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting September 21, 1951, and approved by the Board, November 30, 1951.)

CASE No. 1068-2 (Reopened)

*(Special Ruling)*

*Inquiry:* Is it permissible to use plates of open-hearth or electric-furnace process steel which meet ASTM Specifications A-7-50T, Steel for Bridges and Buildings, A-113-50T, Grade C, Structural Steel for Locomotives and Cars, and A-283-50T, Grades A, B, C, and D, Low and Intermediate Tensile Strength Carbon-Steel Plates of Structural Quality, in the construction of pressure vessels?

*Reply:* It is the opinion of the Committee that these materials may be used for pressure parts in unfired pressure vessels provided all the following requirements are met:

(1) The vessels are not used to contain lethal substances, either liquid or gaseous;

(2) The materials are not used in the construction of unfired steam boilers (See Par. U-2);

(3) The design temperature at which the material is used is between —20 F and 650 F;

(4) The thickness of plates on which strength welding is applied does not exceed $^5/_8$ in.;

(5) The design stresses shall be:

| | —20 to 650 F |
|---|---|
| A-7 — Plates only | 10,100 |
| A-113 Grade C | 8,850 |
| A-283 Grade A | 8,300 |
| A-283 Grade B | 9,200 |
| A-283 Grade C | 10,100 |
| A-283 Grade D | 10,100 |

The factor 1.25 may be applied to these stresses under Pars. U-200 and U-201 of the 1949 and under 1950 Section VIII.

These materials may also be used for Par. U-70 vessels having a shell thickness of $^1/_4$ in. or less, at the reduced stresses provided in that paragraph.

CASE No. 1137

*(Special Ruling)*

*Inquiry:* May a basic longitudinal joint efficiency of 80 per cent be used in designing shells of welded steel heating boilers, providing the welding procedure and operators have been qualified according to Section IX?

*Reply:* It is the opinion of the Committee that an ultimate joint strength 80 per cent of the minimum specified tensile strength of the plate may be used for double-welded butt joints and for single-welded butt joints with backing strips when applying the requirements of Par. H-70 to the design of welded steel heating boilers for any temperatures and pressures permitted under Section IV. For single-welded butt joints without backing strips, an ultimate joint strength 70 per cent of the minimum specified tensile strength of the plate may be used. The following conditions will govern:

1. The welding procedure shall be qualified according to Par. UW-28 of the 1950 Unfired Pressure Vessel Code.
2. Welding operators shall be tested according to Par. UW-29.
3. Identification of welding operators shall be according to Par. UW-37(f).
4. Check of welding procedures and operator qualifications shall be according to Par. UW-47.
5. Inspection during manufacture shall be according to Par. UW-48.
6. Boilers shall be given hammer test according to Par. UW-50(b) and a hydrostatic test according to Par. UW-50(d).
7. Boiler joints shall be spot examined according to Pars. UW-52(a), (c), (e), (f), and (g).
8. When this joint efficiency is used for boiler design, the fact shall be noted on the Manufacturers' Data Report.

This Case does not affect the minimum allowable thicknesses of shell plates as specified in Table H-1.

CASE No. 1145

[*Interpretation of Par. P-23(a)*]

*Inquiry:* May the revised allowable stress values for Tables P-5 and P-7, Section I, published in August, 1951, issue of MECHANICAL ENGINEERING, be used in the pipe wall thickness formula in Par. P-23(a)?

*Reply:* It is the opinion of the Committee that the revised stresses published in the August, 1951, issue of MECHANICAL ENGINEERING may be used in Code construction.

## Proposed Revisions and Addenda to Boiler Construction Code

AS need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code. Simple changes are indicated directly. In the more involved revisions added words are printed in SMALL CAPITALS; deleted words are enclosed in brackets [ ].

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

### Power Boilers 1949

PREAMBLE. Delete "reheaters" from the last sentence and *add* as a new paragraph:

Reheaters receiving steam which has passed through part of a turbine or other prime mover shall conform to Code requirements for superheaters. Piping between the reheater connections and the turbine or other prime mover is not within the scope of the Code.

PAR. P-273(e). Add at end of paragraph:

The individual coefficient $K_D$ as determined by nine tests shall fall within a range of plus or minus 10 per cent of the average coefficient $K$.

PAR. P-288. Insert as new paragraph:

(d) Every reheater shall have one or more safety valves, such that the total relieving capacity is at least equal to the maximum steam flow for which the reheater is designed. At least one valve shall be located on the

reheater outlet. The relieving capacity of the valve on the reheater outlet shall be not less than 15 per cent of the required total. The capacity of reheater safety valves shall not be included in the required relieving capacity for the boiler and superheater.

PAR. P-288(d). Change (d) to (e) and revise to read:

(e) A soot blower connection may be attached to the same outlet from the superheater or reheater that is used for the safety valve connection.

PAR. P-289. Revise first paragraph to read:

Every safety valve used on a superheater or reheater discharging superheated steam at a temperature over 450 F shall have a casing, including the base, body, and bonnet and spindle, of steel, steel alloy, or equivalent heat-resisting material.

PAR. P-301. Revise first sentence to read:

Each steam-discharge outlet, except safety-valve, reheater inlet and outlet or superheater inlet connections, shall be fitted with a stop valve located at an accessible point in the steam delivery line and as near to the boiler nozzle as convenient and practicable.

PAR. P-301. Second paragraph, last sentence; revise to read:

A stop valve is not required at the inlet or the outlet of a reheater or separately fired superheater.

### Material Specifications 1949

EDITORIAL NOTE

The Boiler Code Committee has approved the addition to Section II of the following new specifications:

SA-278-49T, Specification for Gray Iron Castings

SA-7-50T, Specification for Steel for Bridges and Buildings

SA-113-50T, Grade C, Specification for Structural Steel for Locomotives and Cars

SA-283-50T, Grades A, B, C and D, Specification for Low and Intermediate Tensile Strength Carbon-Steel Plates of Structural Quality (Plates 2 In. and Under in Thickness)

SA-333-50T, Seamless and Welded Steel Pipe for Low Temperature Service (NOTE: Delete reference to Note 1 and change reference to Note 2 to read Note 1)

The foregoing new specifications and the ASTM 1951 revisions, also approved by the Boiler Code Committee, of the following specifications will be incorporated in the 1952 edition of Section II. Meantime those in need of them may secure copies from ASTM:

SB-12-51, Specification for Copper Rods for Locomotive Staybolts

SB-42-51, Specification for Seamless Copper Pipe, Standard Sizes

SB-43-51, Specification for Seamless Red Brass Pipe, Standard Sizes

SB-61-51, Specification for Steam or Valve Bronze Castings

SB-62-51, Specification for Composition Brass or Ounce Metal Castings

SB-75-51, Specification for Seamless Copper Tubes

SB-96-51, Specification for Copper-Silicon Alloy Plate and Sheet for Pressure Vessels

SB-98-51, Specification for Copper-Silicon Alloy Rods, Bars and Shapes

SB-111-51, Specification for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock

SB-171-51, Specification for Copper-Alloy Condenser Tube Plates

SB-178-51, Specification for Aluminum and Aluminum-Alloy Sheet and Plate for Use in Pressure Vessels

### Low-Pressure Heating Boilers, 1949

PAR. H-12. Revise second sentence to read:

All sheets, except those having tubes installed by rolling, may be classified as shell plates.

PAR. H-44(c). First sentence: delete "and withstand the preliminary test described in H-45."

PAR. H-45. Delete.

PAR. H-51(d). Delete second paragraph and substitute:

If a manufacturer wishes to apply the Code Symbol to a design of relief valves or steam safety valves, four valves of each pipe size and/or orifice size shall be tested. These four valves shall be set at pressures that will cover the approximate range of pressure for which the valves will be used. The capacities as determined by these four tests shall be plotted against the absolute accumulation test pressure and a curve drawn through these four points. If the four points do not establish a reasonable curve, the authorized observer shall require additional valves tested. From this curve the relieving capacities shall be obtained. The stamped capacity shall be 90 per cent of the capacity taken from the curve.

PAR. H-51(e). Revise third paragraph to read:

Capacity certification tests of relief valves for hot water boilers and tanks shall be conducted at 110 per cent of the pressure for which the valve is set to operate.

PAR. H-97(c). First sentence; delete "and withstand the preliminary test prescribed in H-98."

PAR. H-98. Delete.

PAR. H-104(d), delete second paragraph and substitute:

If a manufacturer wishes to apply the Code Symbol to a design of relief valves or steam safety valves, four valves of each pipe size and/or orifice size shall be tested. These four valves shall be set at pressures which will cover the approximate range of pressure for which the valves will be used. The capacities as determined by these four tests shall be plotted against the absolute accumulation test pressure and a curve drawn through these four points. If the four points do not establish a reasonable curve, the authorized observer shall require additional valves tested. From this curve the relieving capacities shall be obtained. The stamped capacity shall be 90 per cent of the capacity taken from the curve.

### Unfired Pressure Vessels 1950

PAR. UG-31. Delete paragraph (a) and substitute:

(a) *Tubes and Pipe Used as Tubes.* Tubes and pipe when used in lieu of tubes in the construction of unfired pressure vessels shall meet the following requirements:

(1) Additional wall thickness should be provided when corrosion, erosion or wear due to cleaning operations is expected;

(2) Where tube ends are threaded, additional wall thickness is to be provided in the amount of $\frac{0.8}{n}$ in. (where $n$ equals the number of threads per inch);

NOTE: The requirements for rolling, expanding, or otherwise seating tubes in tube plates may require additional wall thickness and careful choice of materials because of possible relaxation due to differential expansion stresses.

Delete paragraph (b).

Change UG-31 (c) to (b) and revise to read:

(b) *Internal Pressure.* The required wall thickness for tubes and pipes under internal pressure shall be determined by the rules for cylindrical shells in Par. UG-27.

Change UG-31 (d) to (c).

PAR. UG-44(a)(3). Delete.

PAR. UG-67. Delete paragraph (d) and substitute:

(d) In design, stresses not to exceed those given in Table UG-23 for temperatures of −20 F to 650 F shall be used.

Delete paragraph (e).

Change UG-67 (f) to (e).

PAR. UG-84(c)(6). Fifth sentence; revise to read:

One set of impact specimens shall be cut from each such test block and this set of specimens shall represent all forgings that are from the same heat of material and given the same heat treatment as the test block, and whose thickness does not differ from that of the test block by more than plus or minus 50 per cent or $1^1/_2$ inches, whichever is less, except that forged flanges and tube sheets thicker than $5^1/_2$ inches may be qualified from a 4-inch test block.

PAR. UW-9. Delete paragraph (c) and substitute:

(c) *Tapered Plate Edges.* A tapered transition section having a length not less than four times the offset between the adjacent plate surfaces, as shown in Fig. UW-9, shall be provided at joints between plates that differ in thickness by more than one-fourth of the thickness of the thinner plate or by more than $^1/_8$ in. The transition section may be formed by any process that will provide a uniform taper. The weld may be partly or entirely in the tapered section or adjacent to it as indicated in Fig. UW-9.

# ASME NEWS

***With Notes on the Engineering Profession***

## ASME Special Committee on Society Policy Releases Progress Report

THE Special Committee on Society Policy, consisting of E. G. Bailey, chairman, Harold V. Coes, and A. R. Mumford, was appointed by the Executive Committee of the Council in January, 1951, for the purpose of reviewing all Society activities. F. M. Gunby and A. L. Penniman, Jr., were later added to the committee. The substance of the Committee's discussion at a meeting held in New York, Aug. 29, 1951, was presented at an informal meeting of the Council and representatives of Boards and Committees at Atlantic City, N. J., on Sunday evening, Nov. 24, 1951, in connection with the 1951 Annual Meeting of the Society. The progress report which follows is quoted from the minutes of the August 29 meeting of the special committee.—EDITOR.

### Publications

The first item discussed was that of publications. It was generally agreed that MECHANICAL ENGINEERING was an excellent magazine and subject to no major criticism. It was also agreed that this magazine should be continued as a free service to members.

The change in publications policy under which Transactions were no longer issued free to the membership has resulted in the reduction of the printing of this volume to something less than 5000 copies at a cost of $35,000 a year. 1200 to 1500 copies are purchased and about 1800 copies are given free to depositories. The suggestion was made that each new member be given a sample copy of Transactions free as an inducement to subscribe for later issues during his membership. Mr. Mumford was asked to study the problem and to report.

The Society now issues two Membership Lists, first, an alphabetical and geographical list and second, a list by companies employing the members. These lists are published in alternate years and thus provide a uniform work load on staff used to prepare these lists. Each issue costs about $8500 and there are 4000 of them so that the cost is about $2.25 per issue. At the present time they are issued to members on request, the alphabetical list free and the company membership at an advertised price of $2. It was generally agreed that the present scheme of publication of each list in alternate years and the limitation of distribution to requests should be continued.

There was a considerable amount of discussion about the publication of papers with particular emphasis on the acceptance of a number of mediocre papers for publication. Suggestions were made as to a National Board of Review with a paid editor whose sole job would be improvement of quality by rigid standards of selection so that the publication of a paper by the Society either in MECHANICAL ENGINEERING or Transactions would become a substantial honor to the author. Other schemes bearing on the improvement of paper quality are discussed under other topics.

### Meetings

The subject of all forms of Society meetings was discussed from the standpoint of costs, attendance, and service to the membership. Suggestions were made that the Spring and Fall meetings of the Society, termed "National Meetings," might well be eliminated and less expensive regional meetings substituted for them. Such regional meetings would require less staff assistance than either the Spring or Fall meeting and if the quality of papers is improved, might well concentrate on local regional interests and thus improve service to the membership.

Divisional Conferences are specialized meetings of groups interested in several fields. Such meetings are growing in number and may well develop into an important method of interchanging information in the engineering profession.

Section meetings are usually small and are in general not of very high quality. Frequently this has been traced to lack of information on the part of the local program committee and in some cases to uninformed and uninspired local committee personnel. It was suggested that the central program help might be improved to the end that objective programs could be developed. We might take a leaf out of the book of the British practice [The Institution of Mechanical Engineers] and encourage the representation of important papers at local sections even by persons other than the author. A house bulletin might be issued to concentrate information of inspiring character and a helpful nature for the local section officers. The problem of indoctrination and inspiration of section and regional officers was discussed and the impression was generally held that such officers have not been properly indoctrinated so that their planning of local-section activities is weak and usually unsuccessful. It was suggested that vice-presidents and past officers should be given some official standing after the completion of their terms of office so that the experience they have gained should continue to be available officially to the sections and regions. It was suggested that proper indoctrination cannot be secured by a short talk to an individual unless that individual has acquired a considerable amount of experience prior to the talk. It might be well to consider more frequent assembly of the vice-presidents in office for long sessions lasting as much as two days where the interchange of ideas could really be worked out to the benefit of all the officers taking part. Ernest Hartford was considered favorably to develop work with the vice-presidents in a similar manner as he has developed it formerly with the Committee on Sections.

Secretary Davies is to formulate a report to the Committee giving in greater detail his ideas on the improvement of meetings some of which have been mentioned in the foregoing notes.

The general feeling that sections and even national officers are not as carefully selected as they might be was traced to certain practices in the selection of nominating committees all down the line. In some regions a rotative system of selecting members of nominating committees has been in effect. This basis of selection of these important individuals on geographical location rather than on specific ability for the job to be done is unfavorable. It was believed that a way should be developed to eliminate this practice.

In order that the National Nominating Committee have the privilege of the consideration of more than one individual for regional officer (VP) it was suggested that each Section in a region be asked to propose a qualified individual in its area with outstanding ability for the job. In this way the National Committee will have several names from which to select the Regional Vice-President. President Brown will offer additional comments on these matters. President Brown and Secretary Davies will offer together comments on Section meetings.

The Executive Committee of Professional Divisions has expressed a desire for more intimate contact with meetings with Council members. A report on this is to be offered by Secretary Davies.

Some criticism of the Organization Committee has appeared and this was considered in some detail. The Organization Committee has certain clearly defined and helpful func-

(*Continued on page 88*)

# TO ASME MEMBERS

## *Suggestions on Society Affairs Requested*

A SPECIAL Committee on Society Policy was formed by act of the Executive Committee of the ASME Council in January, 1951. This Committee was instructed to review all Society activities and report to the Council.

The Special Committee was originally composed of Past-Presidents E. G. Bailey and Harold V. Coes, and Past Vice-President A. R. Mumford. It was expanded later to include also Vice-President F. M. Gunby and Director at Large A. L. Penniman, Jr.

Several meetings of the Committee were held throughout the year. Discussions centered on the following principal topics:

(1) Publications and papers; (2) Meetings; (3) Uniform Dues; (4) Dues a la carte; (5) Finances; (6) Professional Divisions; (7) Research; (8) Development Fund; (9) Outside Related Interests.

The Committee rendered a progress report, based on the minutes of its meeting of August 29, which was discussed by members of the Council and representatives of ASME Boards and Committees at the 1951 ASME Annual Meeting held in Atlantic City, N. J. The substance of the progress report is quoted on pages 86 and 88 of this issue.

I am pleased to report that the Committee has been extended for another year.

Members who desire to do so may send their suggestions relative to the Society to E. G. Bailey, chairman, Special Committee on Society Policy, ASME, 29 West 39th Street, New York 18, N. Y.

It is also suggested that members may wish to submit items for consideration at the regular administrative committee meetings of their Regions.

J. Calvin Brown, *President* (1951)
The American Society of Mechanical Engineers

(Continued from page 86)

tions. There are some gaps between the functions of this Committee and other Committees at different levels. Largely its functions are critical and constructive advice and the establishment of policies for the guidance of Secretary Davies.

### Membership Dues

The consideration of dues was necessary because of the recent increase approved by membership vote and the danger that further increases may be necessitated by the continuing inflation of the nation's economy. It was agreed that every effort should be made to eliminate waste in the operation of the Society, to eliminate costly and useless services to the membership, and to concentrate expenditures on those fields which would produce the most valuable service professionally and from a prestige standpoint to the membership.

The Committee did not feel that a reduction in dues to isolated members because of their inability to attend sectional or national meetings could be justified. There are, of course, justifications for a reduction of dues to inactive members on retirement from active practice of their profession. In most cases this takes the form of paid-up dues.

At the present time the dues are uniform but do not include Transactions. It may be necessary to extend the a la carte idea at some future date to raise the income, but it was not felt that any recognition of geographical differences within the United States or in foreign countries should be reflected in the dues nor should the rate of exchange between the United States and foreign countries be recognized by the partial absorption of the difference by the Society. A member under severe pressure and physically unable to attend meetings can drop the payment of dues and subscribe to MECHANICAL ENGINEERING. In so doing he loses the prestige of membership in the Society and this seems to be something he is unwilling to lose. The Committee believes that he should be required to pay for that prestige.

In the special case under consideration at the present time, involving a group of engineers in Mexico, special treatment differing from that accorded other foreign countries was not felt to be justified by this Committee. There are, however, certain factors which can justify a difference in treatment in other respects than financial. Mexico does not have a strong engineering organization. In the cause of the profession it might be well to spend some effort on building up such an organization by the establishment of a Local Section rather than a group. Payment of full dues would be required even though we recognize that the income of the Mexican engineer does not compare favorably with American engineers of corresponding ability. However, in the cause of the building of an engineering organization in Mexico the return of funds for the operation of the Section might include organization expenses which can not be justified where a strong engineering organization already exists in a foreign country.

### Financial Statement

On the financial condition of the Society it is expected that income items such as dues will increase because of the increase in the dues bills. Advertising in MECHANICAL ENGINEERING is expected to increase about 27 per cent and the Catalog is expected to hold its own. The cost of handling an individual order for a preprint is greater than the price charged and income from the sale of publications is not expected to increase. Prices of copies of Codes and Standards may be raised to a limit at which the gross return levels off.

Under the problems of expenditures some criticism of the allocation of charges to accounts in which individual charges were lost was offered. It is desirable to have specific expenditures available in a manner so that they can be readily separated from the lumped charges appearing in a single account. There is a danger, however, that any complex setup of accounting might be a continuing burden on the Society by increasing overhead. Occasional analysis might provide the answers to problems at specific times but a permanent setup involving great detail in the financial statements might cost more than it would save by making analysis easy.

### Professional Divisions

The opinion has been expressed that there were too many professional divisions and some combination is indicated by the overlapping of activities. Some increased restraint on the formation of new divisions might be instituted by increasing the number of members of the group signing a petition to establish such a division. It might be possible to completely abolish all divisions and replace them with large technical committees which, in the normal course of their activity, would co-ordinate the activities of related groups through their own activities as subcommittees of a large technical committee.

### Research

The problem of research was discussed and generally it was agreed that the number of projects in operation must be increased to properly finance the Society overhead in this field. To increase the number of projects program development is necessary. The project is a building operation and may require some time.

### Development Fund

A development fund was established in about 1945 with the collection of $106,000 by Donald S. Walker who acted as its national chairman. Of this $35,000 remains plus some expenses covered by appropriations from this fund which may be returned. It is now proposed that this fund be replenished by a campaign, now in its planning stages, having the object of collection of $500,000.

### Outside Related Interest

There were several activities of related interests, but outside of the Society, which were examined. It was brought out that such activities require little expenditure of money, particularly those under the joint sponsorship of the Engineers Joint Council. These interests do attract highly qualified individuals willing to give a considerable amount of their time to the activities. It is disappointing that the same attraction does not exist to the same extent for direct activities of the Society.

It was agreed that engineering enrollment in educational institutes must be encouraged because of the increasing shortage of engineering manpower for the defense effort. It was pointed out that European contacts have a prestige value which alone might justify reasonable expenditures when the budget permits and in addition there is an interchange of operational ideas which may save expense or provide better service.

The Society is a member of the National Management Council and is contributing to its activities financially as well as through mutual membership. The contribution is small but is deserving of consideration.

The publication of *Applied Mechanics Reviews* was undertaken after it had been dropped in Germany. The Society has spent approximately $35,000 to date in this operation. Some of this money may be returned after the publication becomes self-supporting which may occur within six months. The Government interest in this publication is expressed by a grant of $20,000 total from two agencies.

### Suggestions

The suggestion was made that the number of members and the grade of members required to form a section be increased in order to prevent the establishment of sections by inexperienced youngsters who could not be considered stable enough to insure a long life to a Society.

It had been suggested that the winners of prize contests at the several Student Conferences in the country be brought together and that a national contest be held. This problem had already been assigned to the Student Development Committee.

## Engineers Needed for National Security

"If engineers fail, the free world fails," said Col. T. A. Weyher, chief, Fire Control Instrument Group, Frankford Arsenal. The topic of Colonel Weyher's talk was "The Engineer in Defense," and was presented by the ASME Philadelphia Section in an effort to co-operate with the Engineering Manpower Commission of the Engineers Joint Council to carry out the theme and purpose of the Engineering Manpower Convocation held in Pittsburgh, Pa., Sept. 28, 1951.

Colonel Weyher's spoke on the needs of national security for professional engineers, the shortage of engineers to do the job, and the measures to be taken by industry to help itself. The speaker used as a background for his presentation the experiences and problems in engineering manpower shortages being encountered by the Ordnance Corps of the Army in connection with the performance of development and design work for the Defense Department.

He emphasized the fact that the most promising avenues for immediate relief of the shortage of engineering personnel are utilization and training. "We must free the engineer as much as possible of those routine tasks that take up so much of his time. . . to rid him of administrative paper work and of subprofessional tasks that can be performed by less highly trained people. We must make

sure that the engineer is given freedom to develop as quickly as he can and that he is given progressively more difficult assignments just as he shows promise of being able to handle them."

In discussing the attitude of our Government with regard to the necessity for the proper use of its engineering manpower, Colonel Weyher stated, "The industrial might of America was the decisive factor in the winning of two major wars within the last 35 years. The war power of America is built upon engineering, industrial management, and raw materials. An essential part of our might is due to our engineering strength. Our potential enemy greatly outnumbers us. We can make up for the disparity in numbers through organizational and technical superiority. We must have the ability to translate the forward thinking of scientists into useful products, and, if necessary, deadly weapons. A substantial number of people in Government appreciate the importance of not permitting a holiday in engineering education to occur again as it did in the last war. If we are to maintain world supremacy technically, it is imperative that our technological fences be kept in repair continuously by present and succeeding generations of engineers."

The speaker was introduced by Ralph Goetzenberger, Fellow ASME, vice-president, Minneapolis-Honeywell Regulator Company, member of the United States Commission of UNESCO, representative for Engineers' Council for Professional Development on the American Council of Education.

# United Engineering Trustees, Inc., Report for 1950–1951

## *Summary of Facts Concerning Building, Finances, Engineering Societies Library, and Engineering Foundation*

THE Annual Report of the United Engineering Trustees, Inc., for 1950–1951 was issued Oct. 25, 1951, by Irving V. A. Huie, president UET. The following excerpts are from Mr. Huie's report:

### Forty-Seventh Year

The Founder Societies, through their authorized members, incorporated United Engineering Trustees, Inc., in 1904, to act for these associated societies in "the advancement of the engineering arts and sciences in all their branches and to maintain a free public engineering library." The broad charter empowers the Corporation to do much more for the Founder Societies than merely to own and operate their building and their library, and to contribute to some of their researches.

The Board of Trustees of UET, Inc., with 47 years of experience, has, as usual, kept in close contact with the affairs of the organization and its normal routine operation. Much special attention has been given to the problem of larger and more modern quarters for the Founder and Associate Societies.

### Engineering Societies Building

The matter of inadequacies of the 44-year-old Engineering Societies Building, dedicated in 1907, a gift from Andrew Carnegie as a center for engineers, to meet up-to-date requirements of the Societies, were given extensive consideration in this report. During the past year the steam lines have required some overhauling, which is a warning that extensive piping may be necessary at any time. Tests required by the City of New York on our elevator safety controls developed the necessity for a new-type safety. The window problem is still with us, frequent local repairs being made each year, postponing as long as possible the complete refenestration which eventually will be necessary. We are endeavoring to keep things going here at the minimum expenditure for renewals with the thought that there may be some way to acquire a new building which will house not only the Founder Societies and present Associates, but include *all* engineering societies, thereby making a real engineering center as was Andrew Carnegie's ideal when he gave the present Engineering Societies Building to "the engineering profession of America."

All available office space in the building is occupied and paying its share of operating costs. The usual annual inspection of the building by our Insurance Counsel assures us of the adequacy of our housekeeping conditions. We now carry $1,904,000 insurance on the building above foundations. The city assessed valuation is $430,000 on the land and $505,000 on the building, all tax-exempt. We continue to receive applications for the purchase of the property.

Since last year, the Library Board has raised some questions about the actual ownership of collections deeded to the Societies and now incorporated in the Engineering Societies Library. This resulted in the draft now in effect of a new Library Agreement, which is less cumbersome and clearer than the previous Agreement in effect since 1915.

### Financial Matters

*Building Depreciation Reserve.* At the close of the fiscal year it amounted to $821,708.88 which after 47 years does not yet equal the original Carnegie gift. No deductions have been made from this reserve for several years so that it is growing at an appreciable rate. Each year $20,000 is added from building income. Interest from investments added another $54,923.23 for this past year.

The Corporation continues to act as treasurer for the Engineers' Council for Professional Development, and as custodian of funds for the John Fritz Medal Board of Award and the Daniel Guggenheim Medal Board of Award, also for contributions to various councils and committees.

ASME Members on the UET Board of Trustees are R. F. Gagg, Warner Seely, and J. L. Kopf.

### The Engineering Societies Library

| | *1949–50* | *1950–51* |
|---|---|---|
| Visitors served......total | 22,283 | 18,104 |
| Nonvisitors served.....total | 14,618 | 16,783 |
| Total | 36,901 | 34,887 |
| Photostat orders | 3,636 | 4,251 |
| Photostat prints | 43,094 | 51,219 |
| Microfilm orders | 153 | 217 |
| Bibliography orders | —— | 635 |
| Searches and paid services | 128 | 114 |
| Translations | 100 | 108 |
| Words translated | 92,249 | 173,656 |
| Borrowers | 1,769 | 1,691 |
| Books lent | 2,534 | 2,425 |
| Telephone inquiries | 5,842 | 6,655 |
| Letters written (exclusive of book orders) | 2,990 | 3,112 |

Ralph H. Phelps, director, Engineering Societies Library, New York, N. Y., in his annual report to the Library Board, stated that greater use is continuing to be made of the services of the Library by nonvisitors. Income from searching, translating, and photo and microfilm copying increased 25 per cent over last year.

### Statistics of Library Use

The Library for some years has conducted confidential searches as requested by companies or individuals needing information on a specific subject. About three years ago the Library began issuing general-interest bibliographies to be sold to anyone interested in the selected topics. The recent prediction made by James B. Conant, president, Harvard University, regarding the rapid progress in the utilization of solar energy was of much interest here because the Library, early this year, had issued a bibliography on the domestic and industrial uses of solar heating.

Another subject covered this year was the management of construction jobs and presently a bibliography on snow, ice, and permanent frost is being compiled.

A new No. 1 photostat machine was purchased to replace a machine that had been in operation for 26 years. A special device on the new machine permits a saving in the amount of photoprint paper use.

Two new monographs were published during the year. These are "Hydraulic Transients," by G. R. Rich, and "Theory of Elasticity" second edition, by Stephen Timoshenko and J. N. Goodier.

The Library staff prepared reviews of 585 books which were supplied to the Founder Societies, The Engineering Institute of Canada, and the Engineering Index.

Among the visitors to the Library were a group of 20 foreign librarians and documentalists sponsored by ECA and another group of a dozen foreign metallurgists sponsored by the American Society for Metals and the ECA; The Engineering Institute of Canada sent

their new librarian for a week's study of our collection and methods and several library-school groups from various cities visited the library. Most of them are especially interested in our classed catalog.

### Periodicals

Each year fewer periodicals are received as gifts. This is no doubt partly due to the increased publishing costs, but it is also due to the Founder Societies discontinuing their own exchanges. The number and the cost of subscriptions and exchanges paid by the Library are increasing. This year our subscriptions were increased by 24, we had 17 additional exchanges, but had 16 less gifts than last year. In continuance of the policy of obtaining the best engineering literature from all over the world sample copies of many periodicals were examined and some subscriptions placed or exchanges arranged. Japanese material was especially studied.

The Library has 170,434 volumes, 12,788 maps, and 5234 searches. Many of the items kept were gifts. They came from many individuals, societies, companies, libraries, and schools. These gifts were helpful as it is difficult or impossible to get some of the material through the usual commercial channels.

J. S. Thompson and Theodore Baumeister represent The American Society of Mechanical Engineers on the Engineering Societies Library Board. Mr. Baumeister is vice-chairman of the Board. Mr. Thompson is on the Administrative Committee.

### The Engineering Foundation

In his annual report, Frank T. Sisco, technical director of the Engineering Foundation, UET, stated:

During the year ending Sept. 30, 1951, the Engineering Foundation had sponsored and made grants toward the support of 16 projects. Fourteen of these 16 projects were active and made excellent progress. Grants totaling $35,800 were approved for the support of these projects. Of this total, $5000 was a special one-year grant to ECPD for the use of an ad hoc committee on professional development at the graduate level in representative communities, and $800 represented an additional appropriation to one ASME project made with an unused grant returned by this Founder Society.

### ASME Projects

The American Society of Mechanical Engineers sponsored several projects; their present status is an active one. These were Lubrication (project 23), Effect of Temperature on Properties of Metals (project 45), Plastic Flow of Metals (project 68), and *Applied Mechanics Reviews* (project 94).

*Lubrication.* During the past year the experimental work on this project on pressure-temperature-viscosity relations for over 40 lubricating fluids was completed. The final report has been written and is now in preparation for circulation.

*Effect of Temperature on the Properties of Metals.* This important project has been under way, with sporadic Foundation support, since 1930. In recent years industry has supported the project liberally and no Foundation grants were requested. For the fiscal year 1950–1951 a grant of $2000 was requested and approved. At the present time the joint ASTM-ASME Committee in charge of the work has 13 projects under way, ten of which are being done co-operatively by Committee members in their own laboratories, while three are being financed by Committee funds.

*Plastic Flow of Metals.* The long-term project on the rolling of metals at M.I.T., which has received support from the Foundation since 1936, will be terminated this year. Recently it has been concerned with the determination of normal and shear stresses at the arc of contact between the roll and the bar. The entire work of this project will be summarized in two papers now in the course of preparation.

The latest phase in determining the coefficient of sliding friction at Illinois Institute of Technology was an investigation of the effect of elevated temperatures and high pressures. The results obtained were at variance with earlier data obtained at room temperature. It was found that oxide films, which formed at high temperatures, reduced the tendency of the sliding surface to gall.

*Applied Mechanics Reviews.* On Oct. 1, 1950, editorial responsibility for *Applied Mechanics Reviews* was transferred from Illinois Institute of Technology to Midwest Research Institute, and since January, 1951, major changes in format have been made. A new feature is the inclusion in each issue of the journal of a survey article written by outstanding men in various fields of applied mechanics.

E. L. Robinson and H. Weisberg served as ASME representatives on the Board of the Engineering Foundation.

## ASME Spring Meeting in Seattle

UNIVERSITY OF WASHINGTON CAMPUS

(The Western Washington Section, ASME, will be host at the 1952 Spring Meeting to be held at the University of Washington, Seattle, Wash., March 24–26, 1952. This beautiful city—celebrating her 100th birthday—located between two mountain ranges, the Cascades and Olympics, and between Puget Sound and Lake Washington, is within a few hours' drive of Mt. Rainier. Since the war Seattle has greatly increased its manufacturing, especially aircraft and shipbuilding. It is headquarters for Boeing.)

## U. S. National Commission for UNESCO

A KEYNOTE address on the place of the United Nations in the world of 1952, to be given at the first plenary session, will set the tone for the National Conference to be held at Hunter College, New York, N. Y., Jan. 27–31, under the auspices of the U. S. National Commission for UNESCO.

Another feature of an early session will be the showing of a documentary presentation highlighting the work of the United Nations and the specialized agencies. Later the delegates, numbering over 2000, will divide into groups according to their special interests, to consider in 13 simultaneous section meetings various programs of international co-operation. Such categories as economic development of underdeveloped areas, education, labor, human rights, cultural activities, and developments toward world law will be included in these section meetings.

### Improving Citizen Understanding

Having as its theme, "The United Nations—Man Helping Man," the conference will focus on means of improving citizen understanding of and participation in world affairs, particularly through the United Nations and the specialized agencies.

Jaime Torres Bodet, UNESCO director general, former Minister of Foreign Affairs of Mexico, is coming from Paris to attend the conference, at which he will be one of the principal speakers. Major addresses will also be given by high United Nations and Government officials and by other prominent UNESCO leaders.

The use of the theater, films, radio, and television in creating a better understanding of world problems will be thoroughly explored at the conference. Delegates will be invited to attend the preparation and presenta-

tion of a preconference television program and a musical and dramatic presentation will be featured on the first evening of the conference. Special film showings will also be held at intervals. The Educational Film Library Association is preparing a list of outstanding feature and documentary films on international themes.

"Building Interest Through Mass Communication" will be the topic of a general session at which outstanding leaders in radio, television, films, and the press (both newspapers and other publications) will evaluate the accomplishments and potentialities of these media in contributing to understanding of international problems.

Among other program features will be sessions at which American attitudes on foreign affairs will be studied, with emphasis placed on ideas and resources for promoting greater understanding of world problems.

The final phase of the conference will be a series of group meetings at which the delegates will study the specific contributions which they can make to the solution of problems both in their professional and functional capacities.

### Exhibits

Exhibits of national and international agencies and organizations will form an integral part of the conference. Among the exhibitors will be the United Nations and several of its specialized agencies; various Government agencies including the Departments of Labor and Interior and the Library of Congress; Engineers Joint Council and numerous national organizations, many of which are represented on the National Commission. Already 75 groups have requested exhibit space.

### Over 500 Organizations Invited

Invitations have gone out to representatives of over 500 national organizations, as well as to national and community leaders in education, science, the arts, business, industry, labor, church, women's, civic, and youth organizations. The invitation list also includes "resource" experts from the United Nations and its specialized agencies, the U. S. Government, universities, schools, the natural and social sciences, engineers, the humanities, the creative arts, business, labor, press, radio, films, and television.

### Engineers Urged to Attend

Admission to the Conference is by credentials only. Engineers who wish to attend should write to Ralph L. Goetzenberger, vice-president, Minneapolis-Honeywell Regulator Company, 1919 K Street, N.W., Washington 6, D. C., representative of Engineers Joint Council on the Commission, who will see that invitations are issued to them.

Engineers will be particularly interested in the program for Tuesday, January 29. At 9:45 a.m. there will be a Mid-Conference Review, followed at 11 a.m. by Work Group Meetings. The general topic of discussion for the Work Groups will be "Strengthening Citizen Understanding Through Education, Research, and Voluntary Organizations." Of the 20 Work Groups, No. 9, National Scientists and Engineers, under the chairmanship of Dr. John S. Nicholas of Yale University, will have the strongest appeal to engineers. The Work Groups will reconvene after lunch to complete their discussions.

# Engineers Joint Council Discusses International Relations, Water Policy, and Unity

A MEETING of the Engineers Joint Council was held in the Engineering Societies Building, New York, N. Y., on Nov. 16, 1951. James M. Todd, president EJC, presided.

C. E. Davies reported that EJC had been asked to co-operate with the National Science Foundation in preparing a national register of engineers. The request was referred to the Executive Committee. Mr. Davies also reported that consideration was being given to a revision and reprinting of the EJC pamphlet, Engineering Societies Year Book, and that studies were under way to develop sufficient demand for the pamphlet so that it could be issued without incurring a deficit. S. E. Reimel reported that the 1951 Annual Report of EJC was nearing completion.

### International Relations

E. A. Pratt, chairman EJC Committee on International Relations, reported briefly on a meeting of the Committee held on Nov. 2, 1951. Plans for the New Orleans meeting of UPADI (Pan-American Union of Engineering Associations), Aug. 25-30, 1952, were discussed. Mr. Todd offered supplementary comments on local arrangements, particularly plant visits; and S. L. Tyler said that progress was being made on the UPADI Constitution and By-Laws. Mr. Pratt said that a letter had been sent from the secretary of EJC to the Secretary-General in charge of the Department of Economic Affairs, United Nations, which included a statement of the general character and activities of EJC, a copy of EJC publication "Principles of a Sound National Water Policy," and a statement of the organized activities of the constituent societies in the broad field of water resources.

In the absence of R. M. Gates, Mr. Pratt also reported that the EJC Commission on Technical Assistance had been asked to develop a task force to advise on engineering personnel to be sent abroad and on the selection of books on subjects that would aid in the economic development of some of the more backward nations.

General Reimel quoted from a letter by J. S. Thompson, a representative of EJC who serves on the board of directors of the United States Book Exchange, under whose auspices books and bound periodicals have been accumulated and sent abroad, particularly to restock war-devastated libraries. Mr. Thompson reported that the Book Exchange has grown to a staff of 28, is handling about 200,000 items per year, and is financed by the State Department and other sources.

Attention was called to the Third National Conference of the United States National Commission for UNESCO, to be held at Hunter College, New York, N. Y., Jan. 27-31, 1952. Prof. H. F. Roemmele, of Cooper Union, New York, N. Y., is preparing an exhibit featuring engineering manpower, for the conference.

### Water-Policy Panel

Copies of a revised edition of the EJC publication, "Principles of a Sound National Water Policy," and a companion pamphlet, "A Water Policy for the United States: A Critique of the Report of the President's Water Resources Policy Commission," by the National Water Policy Panel of EJC, were distributed. E. L. Chandler reported on behalf of W. W. Horner, chairman of EJC National Water Policy Panel, that copies of both publications had been sent to all members of the Congress with a letter signed by the President of EJC. He said that the original task of the Panel was completed, but that much more work remained to be done if the principles set forth by the Panel are to be brought adequately to public notice.

Mr. Chandler reported also on a press conference on the Panel's publication held in New York on Oct. 22, 1951. He was disappointed with the conference, he said; but H. M. Barclay, a representative of *The New York Times* who has aided EJC on many occasions by his advice and the publicity he has given to its work, asserted that the success of such a conference should not be judged by spot news but by continued interest on the part of the press. He stated that feature articles are being prepared by some newspapers based on the report. It was announced that copies of the report, including the "Critique," may be purchased at $1.50 per copy.

E. G. Bailey reported briefly on the EJC Engineering Manpower Commission and its financial condition, which is sound. Personnel of the Commission is undergoing revision, he said.

### Report on Unity Ready Soon

General Reimel read a statement of the Committee for Increased Unity in the Engineering Profession which will be a part of the 1951 EJC Annual Report. The statement reported that the plans for a unity organization, outlined by the Exploratory Group, were submitted to the local sections of EJC societies for discussion and comment and that a plan will be submitted to EJC for consideration at the January, 1952, meeting.

COFFEE HOUR AND AUXILIARY SKIT AT 1951 ASME ANNUAL MEETING
(Representatives of all fourteen sections of the ASME Woman's Auxiliary took part in introducing the Auxiliary's new theme song, "The Spirit of the ASME.")

# Busy Program Marks ASME Woman's Auxiliary 28th Anniversary, at Atlantic City, N. J.

*Mrs. Frank W. Miller Re-Elected President for 1952*

THE 1951 Annual Meeting of The American Society of Mechanical Engineers, at Atlantic City, N. J., marked the 28th Anniversary of the Woman's Auxiliary of the ASME. It also marked the achievement of an Auxiliary goal—1000 members. The Auxiliary now boasts 1050 members in its fourteen sections in various cities.

More than 550 women guests registered at the Annual Meeting, and most all of them came to one or more of the events planned for their pleasure by the members of the Philadelphia section of the Auxiliary. The "Liberty Belles," wearing tiny replicas of the Liberty Bell, tied with the ASME colors of blue and gold, acted as hostesses to all women visitors, Auxiliary members, and guests.

### Annual Meeting Officers

The officers for the Annual Meeting were: honorary chairman, Mrs. Frank W. Miller, the president of the Auxiliary; general chairman, Mrs. Robert W. Worley, chairman of the Philadelphia section; general vice-chairman, Mrs. William M. Sheehan, the vice-chairman of the Philadelphia section. Mrs. George S. Gethen was chairman of registration, assisted by Mrs. B. F. Kenne. Mrs. William S. Karg was chairman of hostesses, assisted by Mrs. R. B. Purdy.

A pleasant, informal tea on Sunday afternoon, in the Vernon Room, Haddon Hall, started off the week's activities. Everyone who had arrived at Atlantic City for the Meeting seemed to attend, to see who else had come, and to say hello to everybody. Mrs. George Auth was chairman of this tea, assisted by Mrs. W. E. Belcher.

Monday afternoon brought a most interesting bird lecture, illustrated by her own color movies, by Mrs. Warner Seely, a member of the Cleveland section of the Auxiliary. Mrs. Charles M. Hickox, sponsor for the Cleveland section was chairman.

Monday evening there was a Bridge Party for the women and their husbands, with lavish door prizes and table prizes for all. Miss Lucille Clarke, assisted by Mrs. A. J. Erlacher and Mrs. T. W. Hopper, was chairman for this enjoyable evening.

A Coffee Hour, Tuesday morning at 10:15, was one of the innovations of the week. Guests were served coffee and coffee cakes and saw a little historical skit depicting the growth of the Woman's Auxiliary, called "For Auld Lang Syne." All fourteen sections of the Auxiliary were represented, even to "Little Minnie." This doll-baby carried in the arms of Mrs. George S. Gethen, expansion chairman of the Auxiliary, represented Minneapolis, the newest section to be organized—just started a week before the Annual Meeting.

### The Spirit of ASME

Best of all, a clever historical skit featured the birth of an ASME Auxiliary theme song: "The Spirit of ASME." See illustration.

This song was written for the occasion by Mrs. Justin J. McCarthy, the chairman of the Coffee Hour, and was presented by Mrs. McCarthy and Mrs. George Auth. Assisting at the Coffee Hour were Mrs. B. C. Berry, Mrs. C. F. Dixon, Mrs. E. A. Lundstrom, and Mrs. A. W. Thorson.

On Tuesday afternoon came the much anticipated Annual Tea Dance. Always one of the most popular events of Annual Meeting Week, this year's Tea Dance was an especially beautiful one. The Vernon Room of Haddon Hall was lovely in a white and green color scheme, the tea table carried out the white and green motif in its flowers and its huge white frosted candles. Mrs. Bernard C. Berry, the chairman of this event, was assisted by these hostesses: Mrs. A. L. Bayles, Mrs. C. W. E. Clarke, Mrs. Crosby Field, Mrs. Paul Gravelle, Mrs. C. H. Kent, Mrs. W. F. Major, Mrs. Justin J. McCarthy, Mrs. G. C. Parr, Mrs. H. I. Robinson, Mrs. A. W. Thorson, and Mrs. B. W. Webb.

The following women took turns pouring: Mrs. Lewis R. Gaty, honoring Mr. Gaty, the general chairman of the Annual Meeting of the ASME; Mrs. Charles M. Hickox, first vice-president of the Auxiliary; Mrs. J. Noble Landis of California, past-president of the Auxiliary; Mrs. G. M. Muschamp, honoring Mr. Muschamp, chairman of the Philadelphia section, ASME; Mrs. Frank W. Miller, president of the Auxiliary; Mrs. William J. Pigott, honoring R. J. S. Pigott, the incoming President of ASME; Mrs. R. B. Purdy, sponsor of the Philadelphia section and Mrs. Robert W. Worley, chairman of the Philadelphia section of the Auxiliary.

### Business Meeting

Wednesday is traditionally the "big day" of the Annual Meeting, and this year was no exception. National president, Mrs. Frank W. Miller, was hostess at a breakfast for the Section Chairman, or their representatives, who were in Atlantic City. The Annual Business Meeting, at 10:30 a.m. on the Sun Porch, Haddon Hall, was presided over by Mrs. Miller, and attended by 85 members. Reports were given by the Auxiliary officers, the chairmen of standing committees, and by the section chairman, if present, or by their representatives, or by the sponsors of the sections. The Auxiliary has sections in Boston, Chicago, Cleveland, Columbus, Los Angeles, New York (the Metropolitan section), Milwaukee, Philadelphia, Pittsburgh, Toledo, Washington, and Fairfield County (Bridgeport, Conn.), Detroit and Minneapolis, the last three being the new sections this year. The Detroit section was only a few weeks old at the time of the Meeting, and Minneapolis, "Little Minnie" in the Auxiliary skit, just a week old.

### Distinguished Guests

Distinguished guests at the business meeting were Dr. Lillian Gilbreth, Mrs. Roy V. Wright, J. Calvin Brown, the outgoing President of the ASME, and R. J. S. Pigott, the incoming President. Each of these guests spoke a few words to the members of the Auxiliary.

Mrs. William E. Karg, chairman, reported on the Calvin W. Rice Memorial Scholarship. Lewis E. Russell of Sheffield, England, holds this scholarship for 1951–1952 and is studying at M.I.T.

Mrs. Kessler, a member of the Student Loan Fund Committee, reported for Mrs. F. H. Fowler, chairman.

The treasurer's report, which will be given in full in the Annual News Letter, reports the Calvin W. Rice Memorial Scholarship Fund

## The Spirit of A.S.M.E.


Corinne McCarthy

Should Auld Acquaintance be forgot
And never brought to mind
And may we meet from time to time
For the sake of Auld Lang Syne.

to contain $2584.73; the Student Loan Fund, $10,790.30 ($6000.00 of this is invested in U. S. Savings Bonds, Series G); the General Fund of the Woman's Auxiliary to the ASME stands at $1980.24. These figures are as of Sept. 30, 1951.

### 1952 Officers

The National Officers for the year 1952 are announced as follows: President, Mrs. Frank W. Miller, Philadelphia: 1st vice-president, Mrs. C. M. Hickox, New York; 2nd vice-president, Mrs. William E. Karg, Philadelphia; 3rd vice-president, Mrs. R. L. Goetzenberger, Washington, D. C.; 4th vice-president, Mrs. A. Cowie, Chicago; 5th vice-president, Mrs. Edward Timbs, Los Angeles; recording secretary, Mrs. Robert W. Worley, Philadelphia; corresponding secretary, Mrs. William L. Illiff, New York; treasurer, Mrs. C. Higbie Young, New York, and assistant treasurer, Mrs. Charles Gladden, New York.

The Annual Luncheon followed the meeting, in the West Room of Haddon Hall, and this "sell-out" affair was another outstanding occasion with 185 men and women present. The West room was decorated with large bouquets of giant white chrysanthemums, and smaller white "mums," white gladioli, and green vines. Frosted candles and white flowers decorated the speakers' table, and each guest at that table wore a white and green corsage. On the grand piano, tall white tapers shed a romantic light on Mrs. Florence Fraser Ludgate, whose delightful "Dramatic Piano Portraits," given after the luncheon, charmed everyone.

Those seated at the speaker's table included Mrs. Frank W. Miller, Auxiliary president, who presided; Mrs. Robert W. Worley, general chairman of the Auxiliary Annual Meeting; Mrs. Allan W. Thorson, the chairman of the luncheon; Mrs. Florence Fraser Ludgate, Mrs. C. R. Davis of Toronto, Mrs. C. M. Hickox, Mrs. H. R. Kessler, Mrs. J. Noble Landis, Mrs. R. J. S. Pigott, and Mrs. Randall B. Purdy.

Mrs. Thorson was assisted by the following luncheon committee: Mrs. B. W. Webb, in charge of decoration; Mrs. George Auth, in charge of tickets; and Mrs. Carl Anderson, Mrs. W. E. Belcher, Mrs. B. C. Berry, Mrs. A. J. Erlacher, Mrs. William E. Karg, Mrs. R. D. Koplin, Mrs. G. C. Parr, and Mrs. J. A. Quaid.

On Thursday morning, as the final event in the women's activities, about forty-five ladies were guests of Haddon Hall in a tour of the hotel kitchens. This proved to be a most interesting half-hour trip into the realm of large-scale housekeeping—many "oohs" and "ahs" greeted the steaks and loins of beef hanging in the freezer rooms, and everyone got hungry in the most fragrant place of all, the bakery, where spicy pumpkin pies were just out of the oven. All were full of admiration at the neat pantries and storerooms and the spotless, modern hotel equipment.

Thus ended the Annual Meeting week for the Woman's Auxiliary and other women guests of the ASME. November 25th to 30th, 1951, will be remembered as a busy, important Auxiliary week, and a delightful one.

Reported by Mrs. B. W. Taylor, chairman, Publicity.

## ASME Pittsburgh Conference

PREPARATIONS are under way for the Pittsburgh Section, ASME, 1952 annual mechanical-engineering conference, which will be held at the William Penn Hotel, in Pittsburgh, Pa., March 18–19, 1952. The Engineering Society of Western Pennsylvania and several other of the local sections of technical societies will co-operate in arranging the program. The general theme of the sessions will center on the conservation of materials and manpower.

## "Applied Mechanics Reviews" Wins Award

EACH year the American Institute of Graphic Arts holds a professional magazine exhibition as an index of current and future trends in the design of printing. From the field of 501 entries, *Applied Mechanics Reviews* is one of 36 designs selected by the jury, on the basis of cover layout designed by ASME staff. It shares honors with such high-budget, high-circulation magazines as *Life*, *Fortune*, *Ladies Home Journal*, *Esquire*, and *Collier's*.

The Magazine Show took place on Nov. 12–23, 1951, in New York, N. Y., at the exhibition rooms of the Society of Illustrators and is now on tour to all the major cities of the United States.

# *To ASME Members:*

## Nominations Open for 1953 Officers

### *This Matter Is Important to You!*

THE 1952 National Nominating Committee of the Society is receiving proposals for candidates for the offices to be filled for 1953. It is the obligation, privilege, and responsibility of every member of the Society to assist the Committee in obtaining the best men available. You can do your part by acting as a sponsor for those members who have the acknowledged qualities of outstanding ability and leadership in their profession.

**Offices to Be Filled**

| | |
|---|---|
| President | To serve 1 year |
| Vice-President | To serve 2 years, Region II |
| Vice-President | To serve 2 years, Region IV |
| Vice-President | To serve 2 years, Region VI |
| Vic. President | To serve 2 years, Region VIII |
| Directors at Large (2) | To serve 4 years |

**Act Now!**

Proposals will be welcomed by the Committee.

1 Proposed candidates' names and records should be submitted on the official proposal form which may be obtained from the Secretary of the National Nominating Committee or any of its members listed below.

2 Completed forms in the required number of copies should be sent to the Secretary of the National Nominating Committee, Cecil R. Davis, Davis Automatic Controls, Ltd., 4251 Dundas Street, W., Toronto 18, Ont., Canada. Proposals for Vice-Presidents should be submitted reasonably in advance of the respective Regional Administrative Committee meetings and proposals for all offices should be submitted before April 1, 1952.

3 The proposer, not the proposed candidate, should fill out the form.

4 Before submitting the name of a proposed candidate, the proposer shall ascertain that the proposed candidate will accept the nomination if tendered.

Members are reminded that, in accordance with the Society's Constitution, candidates for office of President, Vice-President, and Director at Large shall be of the grade of Fellow or Member. Members wishing to speak in support of any proposed nominee have the privilege of appearing before the National Nominating Committee at open hearings to be held during the Semi-Annual Meeting in Cincinnati, Ohio, June 15–19, 1952, Hotel Sheraton-Gibson.

### 1952 National Nominating Committee

*Region I:* William P. Saunier, Jackson & Moreland, Park Square Bldg., 31 St. James Ave., Boston 16, Mass. Raymond H. Tolman, *1st Alternate,* Bay State Abrasive Products Co., West Main, Westboro, Mass. Harry E. Harris, *2nd Alternate,* 229 Thorme Street, Bridgeport 6, Conn.

*Region II:* Kenneth J. Moser, Stevens Institute of Technology, Hudson St., Hoboken, N. J. William H. Byrne, *1st Alternate,* Byrne Associates, Inc., 140 Nassau Street, New York 7, N. Y. W. S. Johnston, *2nd Alternate,* Sanderson & Porter, 52 William St., New York 5, N. Y.

*Region III:* Charles C. Di Ilio, Mech. Engrg. Dept., The Pennsylvania State College, State College, Pa. Charles R. Otto, *1st Alternate,* E. I. du Pont de Nemours & Co., Inc., du Pont Engrg. Dept., Room 12430, Nemours Bldg., Wilmington, Del. W. N. Richards, *2nd Alternate,* International Correspondence Schools, 1001 Wyoming Ave., Scranton, Pa.

*Region IV:* J. A. Keene, *chairman,* Alabama Power Company, 600 North 18th Street, Birmingham 2, Ala. E. M. Williams, *1st Alternate,* Clinchfield Fuel Company, Box 410, Spartanburg, S. C. R. C. Robertson, *2nd Alternate,* Mechanical Engineering Dept., University of Tennessee, Knoxville 16, Tenn.

*Region V:* C. R. Davis, *secretary,* Davis Automatic Controls, Ltd., 4251 Dundas St., W., Toronto 18, Ont., Canada. Henry S. Walker, *1st Alternate,* The Detroit Edison Co., 2000—2nd Avenue, Detroit 26, Mich. E. W. Allardt, *2nd Alternate,* Welded Tube Div., The Babcock & Wilcox Co., Alliance, Ohio.

*Region VI:* Robert T. Mees, Administrative Dept., Caterpillar Tractor Company, Peoria 8, Ill. Robert E. Gallatin, *1st Alternate,* 4132 Warsaw St., Fort Wayne 5, Indiana. R. S. Stover, *2nd Alternate,* R. S. Stover Co., 212 Kresge Building, Marshalltown, Iowa.

*Region VII:* F. B. Lee, Fairman B. Lee Company, 219 Central Building, Seattle 4, Wash. A. R. Weigel, *1st Alternate,* Consolidated Western Steel Corp., 5700 S. Eastern Ave., Los Angeles 54, Calif. S. T. Johnson, *2nd Alternate,* American Smelting & Refining Co., Garfield, Utah.

*Region VIII:* Arnold R. Mozisek, Dallas Power & Light Co., 1506 Commerce St., Dallas 1, Texas. Robert P. Lockett, Jr., *1st Alternate,* A. M. Lockett & Co., 308 Whitney Bldg., New Orleans, La. Carl A. Stevens, *2nd Alternate,* 1932 North Boston Ave., Tulsa 6, Okla.

## ASME Calendar of Coming Events

**March 24–26, 1952**
ASME Spring Meeting, University of Washington, Seattle, Wash.
*(Final date for submitting papers was Nov. 1, 1951)*

**June 15–19, 1952**
ASME Semi-Annual Meeting, Sheraton-Gibson Hotel, Cincinnati, Ohio
*(Final date for submitting papers—Feb. 1, 1952)*

**June 19–21, 1952**
ASME Applied Mechanics Division Conference, The Pennsylvania State College, State College, Pa.
*(Final date for submitting papers—Feb. 1, 1952)*

**June 23–27, 1952**
ASME Oil and Gas Power Division Conference, Hotel Statler, Buffalo, N. Y.
*(Final date for submitting papers—Feb. 1, 1952)*

**June 26–28, 1952**
ASME Applied Mechanics Division, West Coast Conference, University of California, Los Angeles, Calif.
*(Final date for submitting papers—Feb. 1, 1952)*

**Sept. 8–11, 1952**
ASME Fall Meeting, Sheraton Hotel, Chicago, Ill.
*(Final date for submitting papers—May 1, 1952)*

**Sept. 8–12, 1952**
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Cleveland Auditorium, Cleveland, Ohio
*(Final date for submitting papers—May 1, 1952)*

**Sept. 22–24, 1952**
ASME Petroleum Mechanical-Engineering Conference, Hotel President, Kansas City, Mo.
*(Final date for submitting papers—May 1, 1952)*

**Oct. 30–31, 1952**
ASME Fuels and AIME Coal Divisions Joint Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.
*(Final date for submitting papers—June 1, 1952*

**Nov. 30–Dec. 5, 1952**
ASME Annual Meeting, Statler Hotel, New York, N. Y.
*(Final date for submitting papers—July 1, 1952)*
*(For Meetings of Other Societies see page 96)*

NORMAN J. GOULD RECEIVES ASME 50-YEAR MEMBERSHIP PIN

(Norman J. Gould, *left*, president, Gould Pumps, Inc., receiving congratulations upon the presentation of his ASME 50-year-membership pin from A. W. Weber, manager, Corning Glass Works, and chairman, Southern Tier Section, at a meeting held at the Corning Glass Works on Sept. 26, 1951.)

# Junior Forum

## The Training of Young Engineering Graduates in Industry

**By Joseph Schmerler[1]**

THE practice of hiring college graduates to enter a training program with a company, before regular assignment in the company, had its start just prior to World War I. Through the years, training programs have been continually modified and extended, until today this method sometimes is the only way in which a graduate may be employed by a company.

Training programs vary according to the scope of the company. With this in mind, the ASME had as part of the 1951 Annual Meeting in Atlantic City a session devoted to "The Training of Young Engineering Graduates in Industry." The papers presented covered the position of a small company, medium-sized company, and a larger company. The size of the company was not actually reflected in the number of persons employed by the concern, as a matter of fact the small company employs 3500 people, but rather by the range over which its products were applicable.

The smaller-company viewpoint was covered by G. W. Baughman, assistant vice-president, Union Switch and Signal Division, Westinghouse Air Brake Company. E. G. Bailey, chairman of the board, Bailey Meter Company, spoke for the medium-sized company, and H. C. Houghton, assistant to manager of personnel, Bethlehem Steel Company, presented the larger-company's policy.

Mr. Baughman related that his company has a training program which lasts a year and one half. After this course the trainee is permanently attached to a section of the company. Because safety devices on railroad equipment are so highly technical and specialized, the Union Switch and Signal Company is extremely careful in the selection of its candidates for training. It is the responsibility of the chief engineer to recruit college graduates through interviews at various universities, invite prospects for a conducted tour through the plant, evaluate the reports on candidates as to personality, integrity, scholastic record, and reliability, and finally to extend an offer of employment to the successful applicant.

### Training Program

Since only a limited number of engineers are in training at any one time, it is possible for senior engineers to devote a large amount of time to personal contact with the trainee. Besides acquainting the trainee with the function and operation of the various sections he is taught to solve practical problems, operate laboratory facilities, write and interpret technical reports, as well as regular company correspondence. After a year of this "in" training, the young engineer is given field work. He is sent to a customer's facilities where he evaluates the conditions which exist and submits a report.

When the training period is completed, the heads of the departments turn in a report on the trainee and his ability is evaluated. In the light of his preference for assignment, his grading by department, the decision as to placement in a division is made.

A slightly different approach to a training program was offered by Mr. Bailey. His company conducts its course more in the manner of a group activity with a good deal of time devoted to the classroom. The program is divided into a lecture course and an engineering course. Of a practical nature, the engineering course consists of factory assembly and calibration of meters and control units, assignments in taking inventory, routing parts through the shop, preparing shipping orders, inspecting parts, and field-service work.

This program, of a year's duration, is designed to continue teaching the fundamentals necessary to a good engineering education, but is directed more specifically toward the industry within which the company operates. Mr. Bailey believes that a training program should acquaint the trainee with the detailed activities of the individual company and should prompt him toward self improvement through reading, advanced scholastic courses, and activities within the societies of his profession.

The third concept of a training program was offered by a truly large company. Whereas the first two companies manufactured a product, the Bethlehem Steel Company is a fully integrated steel company. It mines the raw materials, produces the iron and steel, and manufactures products ranging from nails to bridges. The training function in the general organization is under the direction of the manager of personnel. The college-graduate training program, called the Loop Course, is handled by the Personnel Division at the central office and hires Loopers after consultation with, and approval by, the heads of the various Bethlehem activities concerned. Matters concerning the hiring of employees for regular work or for various other training programs are done by, and at, the departments and operations involved.

Broadly speaking, the Loop Course is divided into three phases, as follows: Basic training at Bethlehem, Pa., for all Loopers, specialized training in the particular field in which the Looper is to remain engaged, actual training "on the job."

One purpose of the basic phase of training is to acquaint the trainee with the broad Bethle-

[1] Design Engineer, Celanese Corporation, New York, N. Y. Jun. ASME.

hem organization and to have explained, by the people who run them, the various activities of the organization. Each weekday morning the group is addressed by one of the heads of the respective operations as to the functioning of the various activities under his charge.

Also, as part of the basic training, the group is given a thorough grounding in the operation of a steel plant. Movies help to show the relationships of all the activities in a steel plant, and a quick trip around the plant by train provides an on-the-spot opportunity for co-ordination of the activities in the Looper's mind.

For the second phase of training, the main group is broken down into smaller groups, and each one of these is sent to the division in which it is to be trained. This period of training lasts about one year.

The third phase of the Loop Course is the regular work on the job. The first and second phases of the course are the tools with which the Looper has to work. Now the Looper assumes responsibility and demonstrates his ability to deal with the many problems arising in his department.

The progress of each Looper who has completed the course is recorded quarterly in an informal way for the first two years and annually thereafter by a report submitted to the vice-president in charge of the activity in which the Looper is engaged. These reports are readily available and serve as a progress indicator for any Loop-Course graduate.

In comparing the three approaches to a training program it is found that they are generally alike in placing a graduate where he wishes to work and his ability dictates, in stimulating advanced study, and in the methods through which the operations of the company are taught. They vary in the method of cadet selection and possible preassignment to a particular division, in the training in the over-all company operation or the pin-pointing of activity in a section, and in the length of time devoted to the various phases of training.

### Veterans in Training

During the discussion which followed the presentation of the papers, differences between these programs and those of other companies were brought out. Chief among these differences was the approach to salaries offered ex-servicemen. The three speakers agreed that their companies did not offer any extra compensation to a veteran for his added experience, greater maturity when entering training, or possible additional family burden. They did say that veterans were likely to advance more rapidly than younger men because of their added experience so that their pay increased sooner. A different opinion was voiced by H. A. Winne, engineering vice-president of The General Electric Company. Dr. Winne stated that his company employed an equivalent year-of-graduation method in determining at what salary a veteran should start. For example, a graduate of 1948, who would normally have graduated in 1944, would receive a salary somewhere in between the prevailing rate for beginners and that for those who graduated in 1944.

Mention was made of the current attitude of college seniors to ignore the employment interviews held at their schools. It was stressed that numerous companies are having difficulty filling their engineering-manpower requirements. Because a student expects to be drafted shortly after graduation (about 50 per cent leave for the service) does not mean that he should neglect making contact with a company. He should at least get his name on a company list since these lists are referred to often in later years.

A complaint was also registered against the larger company. These companies tend to grab up the best talent for their training programs so that the smaller companies have difficulty getting the men they want. One smaller company found the solution. It picks up the "wastage" from the larger company's training program. Since about 50 per cent of the men in a training course leave the company within a few years of completing the course the smaller company has the opportunity of acquiring a well-trained engineer to be put directly to work. This raised the point of how to keep an engineer in a concern. The answer to which all agreed, aside from money considerations, is to keep an engineer happy on his job doing engineering work.

## W. P. Shiflett Wins Petroleum Division Award

WENDELL P. SHIFLETT, Jun. ASME, mechanical engineer, Celanese Corporation of America, Kingsville, Texas, was recently announced by J. M. Sexton, chairman, Petroleum Division, as winner of the 1951 ASME Petroleum Division award of $50 for his paper, "Drilling by Turbine Method," the best paper written on a petroleum mechanical-engineering subject. The competition was conducted among student members of the Society during the past year. Mr. Shiflett was graduated in June, 1951, from the University of Texas with a BS degree in mechanical engineering.

## Meetings of Other Societies

**Jan. 9**

National Management Council, annual meeting, Hotel Plaza, New York, N. Y.

**Jan. 14–18**

Society of Automotive Engineers, annual meeting, Hotel Book-Cadillac, Detroit, Mich.

**Jan. 21–25**

American Institute of Electrical Engineers, winter general meeting, Hotel Statler, New York, N. Y.

**Jan. 28–Feb. 1**

Institute of the Aeronautical Sciences, annual meeting, Astor Hotel, New York, N. Y.

**Jan. 28–30**

The American Society of Heating and Ventilating Engineers, 58th annual meeting, Statler and Jefferson Hotels, St. Louis, Mo.

**Feb. 7–8**

Instrument Society of America, 1952 regional conference on power-plant instrumentation, Hotel Statler, New York, N. Y

(*For ASME Calendar of Coming Events see page 95*)

## Nominations Sought for ASME 1952 Awards

ALL members or agencies of the Society such as Committees, Sections, and Professional Divisions, are encouraged to submit nominations for the various awards not later than March 1 of each year. Each nomination should be supported by the following: (1) Full statement of the training, experience, and notable contribution of the nominee; (2) statement of the basic reasons for submitting the nomination and for believing the nominee eligible for the honor; (3) other information and reference which will assist the Board on Honors in considering the nominee.

It is absolutely essential that such nomination carry the present title and company connection of the candidate, or if he is retired, his present residence address.

Those wishing to make a nomination should first obtain a copy of a Manual on ASME Honors and Awards. This may be had by writing to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

### Awards for 1951

*Honorary Memberships:* Five may be awarded each year. The Constitution provides the recipients shall be persons of "professional eminence." These awards are not limited to Society members. A nominee must be endorsed by 25 members of the Society.

*ASME Medal:* This award is made for distinguished service in engineering and science, and may be conferred in recognition of general service in science having possible application in engineering.

*Holley Medal:* The award is made for some "great or unique act of genius of an engineering nature that has accomplished a great and timely public benefit."

*Worcester Reed Warner Medal:* This award is made to honor the author of an outstanding contribution to permanent engineering literature. Permanent literature may be a book or group of books, or a single paper or group of papers, not less than five years old, which has (or have) been recognized as a noteworthy and permanent contribution to engineering literature.

## National Science Foundation to Award Fellowships

THE National Science Foundation is planning to award about 400 graduate fellowships in the mathematical, physical, medical, biological, and engineering sciences for the academic year 1952–1953. Stipends will range from $1400 to $3000, depending on the academic status of the recipient, and will include tuition, laboratory fees, and some travel allowances. Fellows will be selected by the National Science Board of the National Science Foundation on the basis of testing and evaluation carried on by the National Research Council.

For further information, write the Fellowship Office, National Research Council, Washington, D. C.

# ASME Elects Five Fellows

The American Society of Mechanical Engineers has honored five members by electing them to the grade of Fellow.

To be qualified as a nominee to the grade of Fellow one must be an engineer who has acknowledged engineering attainment, 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and must have been a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men who, by virtue of their contribution to their profession and to the Society, were so honored are:

### William Edward Caldwell

William E. Caldwell is staff engineer, mechanical-engineering department, Consolidated Edison Company of New York, Inc. In 1913 he entered the employ of The United Electric Light and Power Company, later consolidated with the New York Edison Company into the Consolidated Edison Company of New York, Inc. He has served in the operating and engineering departments of these companies in laboratory, plant, and office as chemist, test, research, mechanical plant, and staff engineer. This work covered the entire field of power-station operation, performance, and design both in a supervisory and consultative capacity. In early field work with direct-fired pulverized-fuel units in Sherman Creek and Hell Gate Stations, he pioneered furnace improvements which reduced the combustible loss and increased the range of acceptable coals for this type of installation. Patents were granted on these designs which are now in general use in many of the largest boiler installations throughout the country. Among other developments which he was instrumental in pioneering were the use of integral feed-heating turbines with topping units for improving thermal economy and flexibility in older plants, Waterside Station, 1936; the first zeolite softening plant for large 1400-psi boilers for high makeup on district steam heating through topping turbines, Waterside, 1938, the use of a feed-heating turbine on boiler feed-pump drive to increase economy by providing additional feed-heating stages between the low-pressure plant and new high-pressure topping installation, Hudson Avenue Annex, 1950. He was responsible for design innovations in simplifying generator and oil-cooling systems in the plants. He has presented papers and discussions at ASME Annual Meetings and in 1933 was recipient of the Melville Medal. He contributed articles to various technical publications. He served the Society as a member, Executive Committee, Metropolitan Section; Executive Committee, Power Division; and chairman, Power Test Code Committee on Steam Turbines.

### Fred Swigart Griffin

Fred S. Griffin, professor and head, department of mechanical engineering, University of Akron, Akron, Ohio, since 1925, retired June 30, 1951, after having been associated with the University since 1921. He achieved his outstanding engineering attainments in the fields of hydraulics, heating, air conditioning, and machine design. He designed and built the original hydraulic laboratory at the University. He was also in charge of all mechanical-engineering laboratories. When the University of Akron was expanded during 1946 to 1950, he designed a new hydraulic laboratory. This laboratory is one of the most modern and it served both the mechanical-engineering and the civil-engineering departments of the University. In addition, Professor Griffin was in charge of the War Training Program during 1942–1945. When he joined the faculty of the University of Akron the mechanical-engineering department had just been instituted. Since that time, mainly due to his efforts, the department has grown and advanced until now the enrollment is larger than in any other department. During the past several years Professor Griffin was also engaged as an engineering consultant to Weather-Seal, Inc., a firm that manufactures storm windows. He is the author of technical papers. For about 20 years he served as Honorary Chairman of the Student Branch of ASME at the University.

### William Gillum Heltzel

William G. Heltzel, consulting engineer, Tulsa, Okla., is closely identified with the progress of the past 25 years in petroleum engineering. Mr. Heltzel's article entitled "Fluid Flow and Friction in Pipe Lines," in the Oct. 7, 1926, issue of the *Oil and Gas Journal*, marked the advent of change from the rule-of-thumb to rational analysis in designing pipe-line facilities. The formulas contained in this article, and subsequent papers, are found in the handbook of the National Tube Company (U. S. Steel) on tubular goods. The data contained in this article were the basis for a hydraulic slide rule, designed and copyrighted by T. R. Aude, which is in general use in industry. At the 1934 ASME meeting of the Petroleum Division in Tulsa, Mr. Heltzel presented a paper on "Derivation of Equivalent Length Formulas for Multiple Parallel Oil Pipe-Line Systems." The information presented in this article has become standard practice in the oil-pipe-line industry for the design of loops to increase capacity and for making analysis of equivalent lengths. Mr. Heltzel also authored numerous other articles on modern designs and operations, which have had a far-reaching effect upon bringing about new practices in the oil pipe-line industry. Since 1946 he has been engaged in consulting work on pipe lines in Saudi Arabia, Terra del Fuego, in the Andes in Bolivia, and on the project located between Santos and Sao Paulo, Brazil. During World War II Mr. Heltzel served as adviser to the U. S. Army on military pipe lines. He sponsored the first corrosion studies for underground pipe lines at the 1926 ASME meeting in Tulsa; and served as chairman of the ASME committee performing the actual work of designing, installing, and demonstrating the automatic pumping station at the International Petroleum Exposition, Tulsa, 1929.

### Ferdinand Jehle

Ferdinand Jehle, consulting engineer to sales, Hoffman Specialty Company, Indianapolis, Ind., is in charge of writing sales literature, the Hoffman Data Book, and is adviser to the staff on engineering problems. His significant contributions to the development of engineering science include organization and installation of research and development laboratories in three companies, thereby pioneering in the application of the scientific method in the design and development of engines, engine parts, and heating-system valves and controls. The benefits of this research are many and varied, such as development of the aluminum engine piston; important methods of testing the performance of engine parts in operation; development work on the White 12-cylinder "pancake" engine; numerous successful temperature-control devices for heating systems; and the invention or co-invention of 11 patented devices, including pistons, engines, heating valves, controls, and instruments. He served the Society as chairman of the local Civic Responsibilities Committee and secretary-treasurer of the Central Indiana Section, ASME, 1944–1945; chairman, 1945–1946. He authored several papers—some covering his work in the automotive field and some on the subject of heating systems and their control.

### Vincent V. Veenschoten

Vincent V. Veenschoten, vice-president, Northern Equipment Division, Continental Foundry and Machine Company, Erie, Pa., is known as an engineering pioneer whose work has helped advance the development of large central-station power plants. In 1912 Mr. Veenschoten was one of a committee of three which developed an entirely new method of regulating the flow of water to boilers—feeding the water continuously while the boilers were underload and varying the water level inversely in the load. This new method permitted operating boilers at a constant steam pressure with a negligible interchange of load. It also increased the safe overload capacity, increased the boiler efficiency, and greatly reduced the hazards of boiler accidents. Most of the subsequent improvements in boiler feedwater regulation have been developed directly by Mr. Veenschoten or under his supervision. Also, all of the development and research work done by the Northern Equipment Company in the last 39 years on desuperheaters, reducing valves, governors, temperature control, and allied equipment has been done under his direction. He is the author of 35 U. S. Patents and 24 foreign patents. In 1912 he organized the Northern Equipment Company with E. W. Nick. At the time the company was organized the Copes Feedwater Regulator was a simple device for regulating the flow of feedwater to steam boilers. The modern Copes system of regulating boiler feed is a highly developed system based on sound engineering principles. Mr. Veenschoten has developed the Copes system to where, today, it is widely accepted in both this country and abroad in both high and low-pressure steam stations. The Copes system has been expanded to take care of service on the largest types of high-

pressure, high-temperature steam generators with the regulating valves themselves actually weighing tons. Three years ago the business was sold to the Continental Foundry and Machine Company and Mr. Veenschoten was retained to assist in expanding the company's activities still further.

* * *

MATERIALS-handling costs, communications developments in materials handling, and materials handling and plant layout are some of the topics to be discussed at the Third Materials Handling Conference to be held at Purdue University, Lafayette, Ind., February 25–26, 1952. The two-day meeting will be sponsored by the General Engineering Department and Technical Extension Division of Purdue University in co-operation with the American Material Handling Society.

* * *

THE fourth annual Industrial Engineering Institute of the University of California will again be presented with the co-operation of The American Society of Mechanical Engineers. The program this year will be offered in two places for the first time; at Berkeley, Calif., Feb. 1 and 2, and at Los Angeles, Feb. 4 and 5, 1952. The meetings will include sessions on training in industrial engineering, analysis of work measurement, quality control, industrial engineering in smaller companies, and office work simplification. Those attending will receive copies of the Proceedings of the sessions. Ralph M. Barnes, Mem. ASME, professor of engineering and production management, is chairman of the Los Angeles meetings and D. G. Malcolm, Jun. ASME, assistant professor of mechanical engineering, at Berkeley, is general chairman.

* * *

A. G. CHRISTIE, Hon. Mem. and past-president, ASME, professor emeritus of mechanical engineering, The Johns Hopkins University, Baltimore, Md., has been made an honorary member of The Japan Society of Mechanical Engineers, Tokyo, Japan. Professor Christie was a member of the Engineering Education Commission which visited Japan during the summer of 1951.

* * *

RAYMOND W. JACOBY of Ciba Company, Inc., received the 1951 Olney Medal at the annual convention of the American Association of Textile Chemists and Colorists, held at the Hotel Statler, New York, N. Y., Oct. 17–19, 1951. The Olney Medal is awarded annually by AATCC as a testimonial to the late Louis A. Olney of the Lowell Textile Institute.

* * *

DONALD L. PUTT, Major General, USAF, acting deputy Chief of Staff, Development, Headquarters United States Air Force, has received the Carnegie Institute of Technology Distinguished Service Achievement Award for outstanding service and accomplishment in the USAF. While serving as chief of the Bombardment Branch at Wright Field, his development work included the B-17, B-25, B-26, B-29, and B-36 aircraft, together with the necessary modifications to convert the B-29 as the A-bomb carrier. General Putt will in the near future become deputy Commanding General, Headquarters Air Research and Development Command at Baltimore, Md.

* * *

WILLIAM GARDNER VAN NOTE, formerly director and head, department of engineering research, North Carolina State College, Raleigh, N. C., was installed recently as president of The Thomas S. Clarkson Memorial College of Technology.

## Engineering Societies Personnel Service, Inc.

*These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.*

| New York | Chicago | Detroit | San Francisco |
|---|---|---|---|
| 8 West 40th Street | 84 East Randolph Street | 100 Farnsworth Ave. | 57 Post Street |

### Men Available[1]

**Mechanical Engineer,** master's degree, former college instructor in thermodynamics. Some stress analysis and analytical design experience. Interested in experimental research or opportunity of handling equipn t. Desires Rocky Mountains or West Coas cation. Me-861.

**Plant Engineer,** 46, MF ow employed, desires plant-engineering position including preventive maintenance, and equipment-project engineering with larger organization; 22 years' experience in chemical and food industries. Me-862.

**Executive,** mechanical engineer, lawyer. Background manufacturing, power-plant design, plant layout, administration, commercial law, corporation law, and aviation law. Desires staff-level position. South America. Me-863.

**Tool and Methods Engineer,** 48, design, process, and shop experience. Total of 27 years, 12 years shop, 5 years board, 10 years executive. American by birth, able to get along and command respect of subordinates. Desires position tool engineering, management, where know-how and responsibility are important factors. Me-864.

### Positions Available

**Chief Design Engineer,** 32–43, mechanical graduate, preferably with experience in special machinery, wire drawing, and light metal work. $9000–$10,000. New York, N. Y. Y-6223.

**Industrial Engineer,** BS degree, one or more years' experience evaluating production data, including chart preparation, to make statistical studies on government project. $4200–$5060. New York, N. Y. Y-6250.

**Technical Writer** for magazine dealing with engineering and management problems mostly from the machine-shop viewpoint. Duties will include the personal preparation of certain feature articles, and will have over-all jurisdiction of all material and scheduling of it for publication. $10,000. Mich. Y-6268

**Chief Industrial Engineer** to head up department in the setting up and revising of incentive rates, production layout; some tooling., for iron and steel-castings manufacturer. Supervisory machine-shop experience. To $7200. Pa. Y-6280.

**Mechanical Engineer,** at least three years' design, layout, and plant-engineering experience, to make equipment layouts, design, and lay out structural changes, etc., in plant-engineering division of paint-manufacturing company. Some traveling. $4160–$5200. Newark, N. J. area. Y-6299.

**Production-Control Engineer,** recent graduate in industrial engineering, one or more years' experience in preparation of bills of materials, engineering drawings, tool specifications, purchasing, and to act as liaison between engineering and manufacturing. $3900–$4420. New York Metropolitan area. Y-6309.

**Engineers.** (*a*) Mechanical engineer, 30–36, minimum of four years' experience on precision-machine work production and manufacture. Position involves the direction of actual operation and manufacture of precision machine parts, prototype units, etc. (*b*) Design engineer-project, mechanical, experience on testing of jet engines or accessories. (*c*) Mechanical design engineer, project, mechanical design experience with equipment involving considerable electronic work. Must be able to work with electronic engineer to produce co-ordinated working equipment. Brooklyn, N. Y. Y-6310.

**Staff Engineer,** mechanical graduate, at least five years' plant-engineering, production layout, and materials-handling experience in textile fields, to make production surveys, economic studies, and plan improvements on cutting and sewing operations for piece-goods manufacturer. Some traveling. $8000–$10,000. Headquarters, New York, N. Y. Y-6314.

**Engineers.** (*a*) Supervisor of industrial relations, under direction of assistant plant manager, to supervise initial screening and selection of all plant, shop, and office employees, induction and termination of employees, plant safety, employee welfare, administration of first aid, prepare and maintain personnel records. Maintain record of labor turnover, accidents, and physical examination, etc. $6000–$8000. (*b*) Tool designer to make designs, sketches, layouts, and design drawings and calculations. Specify equipment tools, and recommend manufacturing procedures for production of fabricated plate and carbon and alloy-cast-steel structures. Prepare and check specifications and bills of materials. Prepare cost estimates. $5400–$7200. East. Y-6324.

**Industrial Engineer** to head up an industrial-engineering program for clay-products manufacturer. Will be responsible for setting up and maintaining wage incentives through time standards, supervisory incentives through standard costs, and methods-improvement and work-simplification programs working through line foremen and superintendents. $6000–$7200. Calif. Y-6329–T-8423.

**Plant Engineer,** building-maintenance and equipment experience, to do planning, make layouts, etc., covering plumbing, heating, electrical, manufacturing equipment, lumber-products plant. $6000–$6500. Northern N. J. Y-6350.

**Engineers.** (*a*) Engineers and designers, preferably mechanical graduates, at least five years' experience in a responsible position in such work as power-plant engineering, writing specifications for mechanical equipment, airplane wind-tunnel design, cement-plant design, and chemical-plant design. $4800–$8000. (*b*) Power-plant-design engineer, thoroughly experienced in large steam-generating-plant work. Qualified to head permanent project group. $10,000–$15,000. Y-6363.

**Mechanical Engineer,** at least ten years' experience in the design of heating, ventilating,

(*ASME News continued on page 100*)

[1] All men listed hold some form of ASME membership.

and air-conditioning systems for all types of buildings. Should have an additional five years' experience in the design of steam-power plants through both low and high-pressure ranges. Residence in Charleston, S. C. area necessary. $7040. Y-6365.

**Design Engineers,** gear and turbine, engineering degree and good scholastic record in engineering mathematics essential. Test floor, calculating, and design experience with manufacturers of steam and gas turbines, axial-flow compressors, and large high-speed reduction gears preferred. Salary open. Central N. J. Y-6370.

**Engineers.** (*a*) Industrial engineer, 35-45, with practical experience, preferably in consultant's office on office and clerical methods. Considerable traveling. (*b*) Industrial engineer with similar experience, but in addition, must have worked on micromotion studies. $8500-$10,000. New York, N. Y. Y-6382.

**Mechanical Engineer** with electrical experience in simplified electronics. Must have had six to eight years' experience in the electrical-mechanical field. Salary open. Location, upstate New York. Y-6384.

**Sales Engineers.** (*a*) Sales engineer, mechanical, 35-50, at least three years' experience selling conveyers or materials-handling equipment, preferably as a manufacturer's agent. Knowledge of rock crushing. Will sell conveyers to mines, quarries, and rock-crushing plants, for a manufacturer of heavy equipment. $4800 drawing against commission. Car required. (*b*) Sales engineer, mechanical, 35-50, three years' experience selling construction equipment, preferably as a manufacturer's agent. Knowledge of rock crushing and construction. Will sell heavy construction equipment to contractors, municipalities, and other users, for a manufacturer of heavy equipment. $4800 drawing against commission. Tenn. T-8384.

**Designer,** two years of college and seven years' experience in the mechanical design of cameras, optical instruments, small mechanisms, gear trains, motors, clutches, brakes, etc. Knowledge of electrical, electronic, or optics desirable. Will design products in detail, in co-ordination with a project engineer, and will make layouts from which detailers could work. Aerial photographic equipment. $5000-$8000. Ill. R-8397(*b*).

**Management and Industrial-Engineering Consultant,** BS in engineering, 30-40, five years' experience in practical manufacturing with emphasis on industrial-engineering activities. Knowledge of organization, methods, plant maintenance, time study, wage administration, controls, industrial relations. Performing consulting in the fields of management and industrial engineering with clients for a general manufacturing business. $10,000. Location subject to changing assignments in United States and Canada. R-8415.

## Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Jan. 25, 1952, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

*For Member, Associate, or Junior*

Anderson, Lehman E., Newton, Iowa
Atherton, George H., Corvallis, Ore.
Barr, Frank L., Salt Lake City, Utah
Bailiff, F. H., Charleston, W. Va.
Baker, James E., Springfield, Ill.
Baral, Paul, Silver Spring, Md.
Barnhill, Jarrell L., Levittown, L. I., N. Y.
Bates, John L., Cleveland, Ohio
Bennett, A. C., West Lawn, Pa.
Bennett, Clifford W., Denver, Colo.
Bradley, Glenn F., Malvern, Ark.
Buell, Vincent F., Houston, Texas
Burch, Arthur B., Berkeley, Calif.
Byerly, T. Edward, Baltimore, Md.
Camden, Graham B., Coffeyville, Kan.
Carey, Norman W., Chicago, Ill.
Castiglioni, Bruno P., Beaumont, Texas
Clarke, W. R., Tulsa, Okla.
Cleveland, Charles H., Springfield, Mass.
Cottam, Harold J., Morris Plains, N. J.
Crosby, S. A., Chicago, Ill.
Dauer, Raymond F., York, Pa.
Davenport, Robert W., South River, N. J.
David, Walter D., Cleveland, Ohio
Dawson, Thomas J., Pascagoula, Miss.
Deadman, W. W., New Orleans, La.
DeLuca, Everett B., Colonial Heights, Va.
Dorwart, Kenneth G., Lancaster, Pa.
Drucker, Francisco, Mexico, D. F., Mex.
Ellsworth, William M., Jr., Silver Spring, Md.
Engstrom, John E., Michigan City, Ind.
Fleming, William O., Pittsburgh, Pa.
Flounders, John M., Colchester, England
Fowler, W. E., Denver, Colo.
Franz, Anselm, Williamsport, Pa.
Futrell, Archie W., Jr., Mt. Holly, N. C.
Gahm, Herman, New York, N. Y.
Goldstein, Richard J., Oak Ridge, Tenn.
Goodwin, Walter W., Media, Pa.
Gradous, Fred J., Jr., Chicago, Ill.
Haddix, Robert J., Dayton, Ohio
Hagen, Theodore G., Cincinnati, Ohio
Hardin, Thurman C., Wilmington, Del.
Harrison, Eugene E., Berkeley, Calif.
Holland, Charles H., Phillipsburg, N. J.
Holton, W. C., Columbus, Ohio
Hunter, Wesley L., Newark, Ohio
Johnston, Carl C., Detroit, Mich.
Joseph, Walter T., Kingston, Pa.
Keen, John F., Newark, Del.
Kirwin, Ralph S., Royal Oak, Mich.
Kobb, Frederick S., Kew Gardens Hills, L. I., N. Y.
Korda, Peter B., Elizabeth, N. J.
Korman, John G., Bishop, Texas
Krueger, Richard E., Denver, Colo.
Kwo, William T., Schenectady, N. Y.
LaFevre, Louis B., Augusta, Ga.
Laros, Robert K., Allen Park, Mich.
Larsen, John J., Longview, Wash.
Latif, Mohammad A., Moghalpura, Lahore, Pakistan
Levinson, Toby E., Los Angeles, Calif.
Lindsay, Russell F., Wilmington, Del.
Livingston, Alex C., Kilmarnock, Scotland (Rt & T)
McDermott, Franklin, Darien, Conn.
McDonald, Ambrose J., Jr., Denville, N. J.
McLaughlin, Daniel J., Pittsburgh, Pa.
Mead, Francis W., Watkins Glen, N. Y.
Minnick, C. T., Grand Island, Neb.
Montroy, Sam F., Port Arthur, Texas
Moore, Oran H., Houston, Texas (Rt & T)
Morgan, Jack E., Toledo, Ohio
Morton, L. C., London, England
Newton, Richard Y., Scotia, N. Y.
Noe, John W., Brooklyn, N. Y.
Nordgren, Harry C., Jr., Toledo, Ohio
Orloff, Arthur, Lansing, Ont., Can.
Ott, Dudley E., Berkeley, Calif.
Pearson, William R., Bellflower, Calif.
Pelaez, Francisco F., Mexico, D.F., Mex.
Pettibone, Robert S., Detroit, Mich.
Pflug, W. W., Jr., Cranford, N. J.
Phillips, Thomas W., Greensburg, Pa.
Pocock, John W., Chicago, Ill.
Poole, David E., Newton Falls, Ohio
Powell, William T., Ridley Park, Pa.
Quick, Donald M., Newark, N. J.
Reid, Alan B., Minneapolis, Minn.
Renson, Richard J., New York, N. Y.
Rosnyai, William A., Allen Park, Mich.
Sajanlal, Hyder Ali, Karachi, Pakistan
Schanne, Francis A., Newton, Pa.
Scheuermeier, Eduard, Wauwatosa, Wis.
Schmitt, Karl H., Mt. Clemens, Mich.
Selwyn, Raymond J., Sherman Oaks, Calif.
Shapiro, Sumner, New York, N. Y.
Shekhdar, N. M., Bombay, India
Sinnott, Richard J., Detroit, Mich.
Skelton, Emerson W., Sarnia, Ont., Can.
Smith, Verl R., Garfield, Utah
Sorstmeyer, Christoph K., Tullahoma, Tenn.
Soroka, Walter W., Berkeley, Calif. (Rt & T)
Spencer, William H., East Haven, Conn.
Strauss, Howard E., Buffalo, N. Y.
Sutton, James F., Clemson, S. C.
Thayer, A. L., Buffalo, N. Y.
Thomas, E. L., Mt. Holly, N. C.
Trapp, Frederick J. J., Norristown, Pa.
Tucker, John P., Lake Charles, La.
Valenzuela, L. H., Mexico, D.F., Mex.
Van Der Ploeg, Guy W., Crum Lynne, Pa.
Veerkamp, Walther H., Mexico, D.F., Mex.
Von Wrangell, Charles P. E., Northport, L. I., N. Y.
Wagner, Joseph O., New York, N. Y.
Wajnowski, Stanley M., West Haven, Conn.
Weaver, Harry E., Cleveland, Ohio (Rt & T)
Wetzel, Richard E., Oxnard, Calif.
Williamson, Thomas N., Bellaire, Texas
Wise, William M., Ardmore, Pa.
Wolf, Sumner, Montreal, Que., Can.
Wright, Wilbur W., Omaha, Neb.
Wyss, Guido, Denver, Colo.
Yawn, R. W., Thomaston, Ga.

CHANGE IN GRADING

*Transfers to Member and Associate*

Barkovitz, William E., Lincoln Pk., Mich.
Clymer, A. B., Toledo, Ohio
Frankenfield, C. Walter, Bayonne, N. J.
Gould, William R., Long Beach, Calif.
Gulrajani, B. K., Bombay, India
Kiewit, Alfred L., Cincinnati, Ohio
Kobb, Leonard C., Richland, Wash.
Krueger, Herbert W., Sr., Beaver Dam, Wis.
Lepren, Edward K., Kingston, N. Y.
Loeffler, J. Edward, Jr., Houston, Texas
Logan, George H., Park Ridge, Ill.
Monroe, Paul H., Jr., Pasadena, Calif.
Smalenberger, Edward A., Jr., Westfield, N. Y.
Surinak, John J., Iron Mountain, Mich.
Thompson, Glenn A., New York, N. Y.
Touloukian, Y. S., Lafayette, Ind.
Widell, Herbert A., Chicago, Ill.

*Transfers from Student Member to Junior* ...... 50

## Obituaries

**William Charlewood Ellis (1902-1951)**

William C. Ellis, general superintendent, Kingsport (Tenn.) Foundry and Manufacturing Corp., died Feb. 26, 1951. Born, Memphis, Tenn., Jan. 9, 1902. Parents, Samuel James and Elise (Crockett) Ellis. Education, high-school graduate; ICS. Married Lucille Nichols, 1926. Mem. ASME, 1938. Survived by wife and two children, Mrs. William Gignilliat and William C., Jr.; his mother, two brothers, James and Crockett, and a sister, Mrs. Marion Bickford.

**Charles Andrew Flynn (1880-1951)**

Charles A. Flynn, retired vice-president, treasurer, Flynn-Hill Elevator Corp., New York, N. Y., died Feb. 27, 1951, in Plainfield, N. J. Born, Troy, N. Y., Feb. 6, 1880. Parents, James A. and Anna B. (Fields) Flynn. Education, ME, Cornell University, 1905. Married Katherine E. Flynn, 1908. Mem. ASME, 1916. Survived by wife and seven children, Mrs. Richard A. Hyer, Plainfield; Charles A., Jr., Westfield, N. J.; James A., Plainfield; Robert L., Albuquerque, N. Mex.; Mrs. Martin W. Davenport, Plainfield; John V., Penns Grove, N. J.; and Richard P., Plainfield.

**Harry Gray (1883-1951?)**

Harry Gray, president, Gray Contracting Co., Somerset, Pa., died Oct. 19, 1951, at Presbyterian Hospital, Pittsburgh, Pa. Born, Liverpool, England, Oct. 1, 1883. Education, 3 years, Liverpool Central Technical College; 3 years, Liverpool University College; 3 years, Glasgow Technical. Married Mary Stovall 1926. Mem. ASME, 1928. Survived by wife.

**Edwin Wesley Hammer (1867-1951)**

Edwin W. Hammer, consulting engineer, expert on electrical and mechanical patents, and an associate of Thomas A. Edison, died Oct. 11, 1951, at his home in Montclair, N. J. Born, Newark, N. J., Dec. 16, 1867. Parents, William Alexander and Anna Marie N. (Lawton) Hammer. Education, high-school graduate, attended Polytechnic Institute of Brooklyn. Married Emily A. Thompson, 1890. He invented and held U. S., Australian, British, and Canadian patents on a number of mechanical and electrical devices. As a patent consultant, he, who was largely self-taught, advised many large corporations, including the General Electric Co., General Motors Corp., and Westinghouse Electric and Manufacturing Co. He was coauthor of "The X Ray; or Photography of the Invisible," 1896; "Cataphoresis," 1898. He was founder and former president of the Edison Pioneers, an organization of men who had worked with the inventor. Mem. ASME, 1913. Survived by wife and son, Wesley T.; and a sister, Mrs. Harold Francis, Lenox, Mass.

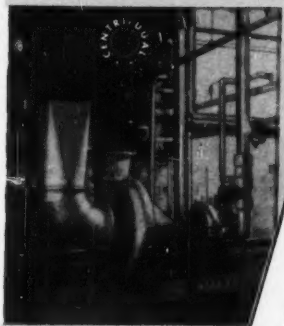
**Harold Lester Heywood (1896-1951)**

Harold L. Heywood, supervisor, development engineering department, Kearney and Trecker Corp., Milwaukee, Wis., died Aug. 20, 1951. Born, Pawtucket, R. I., Aug. 30, 1896. Parents, William Albert and Florence Belle Heywood. Education, high-school graduate; technical-drafting course, Brown and Sharpe Manufacturing Co., Providence, R. I., 1917. Married Jennie O. Mackinnon, 1915; children, Ruth O., Harold F., William J., Robert W. Mem. ASME, 1941. Served the Society as alternate delegate, Region VI, National Nominating Committee, 1950-1951. He held patents on machine tools and

(*ASME News continued on page 102*)

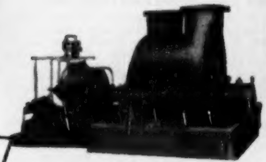
# BEFORE BUYING *any* BLOWER COMPARE THESE ESSENTIALS

THE DUAL-ABILITY LINE OF MODERN EQUIPMENT TO HANDLE GAS AND AIR

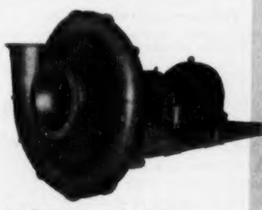


Single-Stage, Type OIB Centrifugal Blower in food processing plant. Steam turbine drive. Capacity 12,000 cfm.

- ☐ Choice of Rotary or Centrifugal
- ☐ Capacity matched to the job
- ☐ Easy accessibility
- ☐ Ruggedness
- ☐ Ease of installation
- ☐ Ability to handle overloads
- ☐ Long-time durability
- ☐ Freedom from breakdowns
- ☐ Low maintenance costs
- ☐ Engineering assistance
- ☐ Proved reputation of maker
- ☐ Customer satisfaction

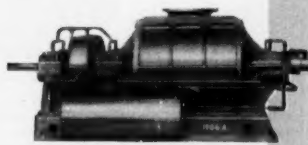


Multi-Stage Centrifugal Exhausters



Single-Stage Centrifugal Blowers

Rotary Positive Blowers



Rotary Positive Gas Pumps

When production depends so vitally on adequate handling of gas or air, you can't afford to take chances on the performance of your blowers or exhausters. It's better to be safe than sorry.

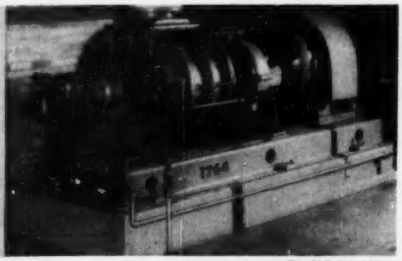
So, for new installations or replacements, we suggest that you evaluate the equipment by the above standards of comparison. This will help determine the unit that will be most effective, economical and reliable for your specific applications.

Be sure to include the R-C *dual-ability* line of both Centrifugal and Rotary Positive types. Remember that only we offer you this *dual choice*—with unbiased recommendations from almost a century of experience. With capacities from 10 cfm to 100,000 cfm or higher at moderate pressures, R-C equipment has a long record of outstanding performance in industrial applications.

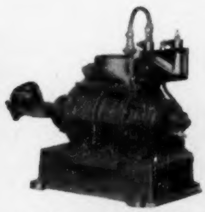
We'll gladly send detailed information for comparison—or supply engineering help if we can be of service.

ROOTS-CONNERSVILLE BLOWER CORPORATION
521 Michigan, Connersville, Indiana

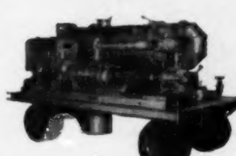
ROTARY



Type RCDH Blower in electric power plant, with capacity of 3,380 cfm.



Positive Displacement Meters



Inert Gas Generators

Reg. U.S. Pat. Office

ROOTS-CONNERSVILLE

BLOWER BUILDERS R-C SINCE 1854

ONE OF THE DRESSER INDUSTRIES

spindles and was the author of technical papers, which were published in professional journals.

**John Maitland Hopwood (1883–1951)**

JOHN M. HOPWOOD, chairman of the board, Hogan Corp., Pittsburgh, Pa., and subsidiaries, died June 8, 1951, in Vero Beach, Fla. Born, London, England, April 1, 1883. Parents, John and Annie Elizabeth (Gilbert) Hopwood. Education, public schools in England (classical education). Naturalized U. S. citizen, 1908. Married Grace Whitford, 1913. Mem. ASME, 1922; Fellow ASME, 1949. Held numerous patents on automatic control apparatus. During World War II he was president, War Materials, Inc. Survived by wife and three children, Mrs. D. K. Richardson, Vero Beach, Fla.; John M., Jr., and W. W. Hopwood, Pittsburgh, Pa.; and seven grandchildren.

**Paul Lawrence Irwin (1899–1951)**

PAUL L. IRWIN, manager, gas-turbine laboratory, Baldwin Locomotive Works, Philadelphia, Pa., died Aug. 5, 1951. Born, Bradford, Pa., Oct. 2, 1899. Parents, Guy White and Mary Agnes (Ryan) Irwin. Education, BS, Carnegie Institute of Technology, 1921; ME, 1926; postgraduate work with Dr. S. Timoshenko and Dr. A. Nadai. Married Norma Grace Yeager, 1930. Author of many technical articles and held U. S. Patents on torsion testing machines. Jun. ASME, 1922. Survived by wife.

**William Kenneth Kirby (1891–1950)**

WILLIAM K. KIRBY, consulting petroleum engineer, Altadena, Calif., president and general manager, Compania de Petroleo Ganso Azul, Ltda., Lima, Peru, S. A., died Oct. 4, 1950, in New York, N. Y. Born, Salt Lake City, Utah, July 30, 1891. Parents, Charles and Martha (Woodward) Kirby. Education, California School of Mechanical Arts; attended San Francisco University, Utah Agricultural College, and Colorado School of Mines. Married Dorothy Garrison, 1927. Assoc-Mem. ASME, 1919; Mem. ASME, 1923. Survived by wife.

**Bernard William Kohnen (1916–1951)**

BERNARD W. KOHNEN, designer, central engineering department, United States Rubber Co., died Sept. 10, 1951, in Chicago, Ill. Born, Chicago, Ill., Aug. 19, 1916. Parents, Paul William and Alma (Green) Kohnen. Education, ME, Marquette University, 1940; postgraduate work at Armour Institute of Technology and Northwestern University. Married Alice Fischer, 1942. Jun. ASME, 1941. Survived by wife and son, James B.; mother and two brothers, Paul B. and William J.

**Edmond Frederick Neuberger (1895–1950)**

EDMOND F. NEUBERGER, ordnance engineer, Department of Army, Picatinny Arsenal, Dover, N. J., died Nov. 25, 1950. Born, New York, N. Y., Sept. 3, 1895. Parents, Otto and Emma (Baeuchle) Neuberger. Education, BS, Cooper Union, 1921; CE, 1928. Married Lillian Cleveland, 1920. Mem. ASME, 1948. Survived by wife and two children, Lillian C. Rose, Takoma Park, Md.; Edmond D., Dover, N. J.

**Eric Oberg (1881–1951)**

ERIC OBERG, consulting editor, for 46 years on the editorial staff of *Machinery*, technical journal, and widely known throughout the metal-working and machine-tool industries of America and Europe, was killed in an automobile accident in Rockford, Ill., Oct. 22, 1951. Born, Veramo, Sweden, March 1, 1881. Parents, Andreas and Maria (Brostedt) Oberg. Education, ME, Boras Technical College, 1900. Naturalized U. S. citizen, Brooklyn, N. Y., May 22, 1908. Married Emily A. Mitchell, 1905 (died 1941); son, Henry V. Married 2nd, Helena E. Woodall, 1941. Assoc-Mem. ASME 1913; Mem. ASME, 1919. He served the Society as chairman, Finance Committee, 1920–1925; Treasurer, 1925–1935; Meetings and Program Committee, 1939–1941; Medals Committee, and Small Tools and Machine Tool Elements Standardization Committee. He edited "Machinery's Engineering Handbook" and "Machinery's Engineering Encyclopedia." He also wrote numerous other technical books in the machine building field as well as articles published in technical journals. In World War I he was a member of the Committee for Adjusting the Industries to War Work appointed by the Government. During World War II he served a period with the War Department as consultant to the Army Air Forces. He was also vice-chairman of the Manufacturing Engineering Committee of the ASME working under the auspices of the War Production Board. Survived by wife, son, Henry V., Cleveland, Ohio, and a stepson, Wilbert A. Mitchell, Springfield, Vt.

**David Walter Pye (1879–1951)**

DAVID W. PYE, president, Tuco Products Corp., New York, N. Y., died Sept. 8, 1951. Born, Brooklyn, N. Y., Nov. 5, 1879. Parents, Robert C. and Margaret (Carter) Pye. Education, Leigh College, 1894–1896; Kissicks Business College, 1896–1898. Married Florence B. Edgett, 1904. Assoc. ASME, 1946. Survived by wife and daughter, Orrea Florence.

**Albert Lawrence Rohrer (1856–1951)**

ALBERT L. ROHRER, retired advisory engineer, General Electric Co., died Oct. 18, 1951, at his home in Maplewood, N. J. Born, Farmersville, Ohio, Feb. 29, 1856. Parents, Aaron and Elizabeth (Ozias) Rohrer. Education, graduate Farmersville Normal School, 1878; studied physics and mechanics, Ohio State University, 1879. Married Carrie L. Gould, 1891; daughter, Miriam. From 1892 to 1914 he recruited and supervised the training of engineering personnel for General Electric. His work took him to 70 United States colleges and universities and he carried on correspondence in England, France, Germany, Sweden, China, Japan, and South American countries. In that period 3000 college graduates were brought to the company. He held the fifth class order of Chia Ho of China. Mem. ASME, 1896. Survived by daughter, Mrs. Joseph Bryan Shelby.

**James Reid Stoner (1924–1951)**

JAMES R. STONER, instrument design and development engineer, Gulf Research and Development Co., Harmarville, Pa., died Sept. 25, 1951, Born, Ruffsdale, Pa., June 15, 1924. Parents, James Blaine and Clara A. (Bolton) Stoner. Education, BSME, Carnegie Institute of Technology, 1948. Married Ruth Jane Konkle, 1950. Jun. ASME, 1948. Survived by wife.

**Alfred Vaksdal (1886–1951)**

ALFRED VAKSDAL, director of plant expansion Corning Glass Works, Corning, N. Y., died of a heart attack, Oct. 9, 1951, in Danville, Ky. Born, Bergen, Norway, April 13, 1886. Parents, Thomas and Ingaborg Vaksdal. Education, graduate Hambro Skole, Bergen, Norway; ME, Horten, 1908. Naturalized U. S. citizen, Chicago, Ill., Feb. 16, 1910. Married Ragna Gangnes, 1910. Mem. ASME, 1924. Survived by wife and son, Steinar, Mem. ASME, Lowland, Tenn.

## Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult reverse side of card for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting your address, business connection, and Professional Divisions enrollment is printed on this page. Please use it to keep the master file up to date.

Four weeks are required to complete master-file changes.

### ASME Master-File Information

*(Not for use of student members)*

**Please print** **Check mailing address**

Name ..................................................
Last First Middle

Home address .................................................. ☐
Street City Zone State

Name of employer ..................................................

Address of employer .................................................. ☐
Street City Zone State

Product or service of company ..................................................

Title of position held ..................................................

Nature of work done ..................................................

Please register me in three Professional Divisions as follows:

1 ..................................................

2 ..................................................

3 ..................................................

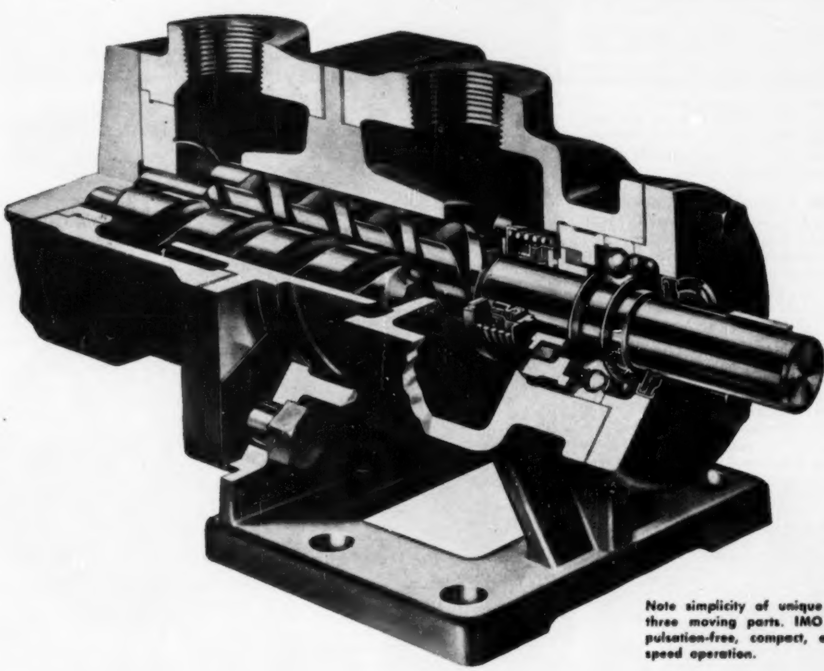
*(Processing of address change requires four weeks)*

I am a subscriber to (please check)

Transactions ☐ Journal of Applied Mechanics ☐ Applied Mechanics Reviews ☐

# NOW...a new LOW-COST IMO

# for HIGHER pressures



Note simplicity of unique IMO design—only three moving parts. IMO is reliable, quiet, pulsation-free, compact, excellent for high-speed operation.

You've either heard about or used the proven De Laval—IMO A313A pump. Now De Laval brings you the A313B IMO for a wide variety of oil handling applications for higher pressures. This quality-designed, quantity-produced pump saves you up to 40% in initial cost over other IMO models for pressures up to 275 psi.

This new rotary positive displacement pump gives you all the advantages of the famous IMO pumping principle. Use it for capacities to 80 gpm, pressures to 275 psi and intermittent pressures to 325 psi... It handles light or viscous fluids in hydraulic systems, rotary and steam atomizing oil burners, lubrication, governing systems and similar services.

DE LAVAL OFFERS IMMEDIATE DELIVERY OF NEW IMO PUMP! WRITE TODAY!

DE LAVAL IMO Pumps

STANDARD PRODUCTS DIVISION

DE LAVAL STEAM TURBINE CO., TRENTON 2, NEW JERSEY

DL-124


To keep plant operating costs down to earth
To fulfill its tremendous task of building engines and other aircraft components for defense and civilian needs, United Aircraft Corporation is in an almost continuous state of expansion.
An addition to the power house at the main plant in East Hartford (below) has recently been completed. The $12,000,000 Andrew Willgoos Turbine Laboratory was finished and put in operation on jet research in the past year. Under construction are new plant facilities at the Pratt & Whitney Aircraft Division in North Haven, and the Hamilton Standard Division in Windsor Locks, Conn.
When it comes to plant operation, United Aircraft is right down to earth. To make sure of lasting efficiency and low maintenance in fluid control, they chose Jenkins Valves for all of these new buildings. At the right is a typical valve station in the vast network of piping at the Willgoos Laboratory.
Long a leader in the development and production of piston engines, notably the famed Wasp, the Pratt & Whitney Division is now a major producer of jet engines like the J-48 Turbo Wasp that powers the Navy's new Grumman Panther, shown above.
Design Engineers:
ALBERT KAHN ASSOCIATES, DETROIT, MICH.
General Contractors:
THE WADHAMS & MAY COMPANY, HARTFORD, CONN.
Piping Contractors:
THE [illegible] & VAN STONE DIVISION
MIDWEST PIPING & SUPPLY CO., INC., BOSTON, MASS.
United Aircraft Corporation relies on
On their low upkeep cost record, Jenkins Valves are being specified for more and more of the new industrial plants, the modern commercial, institutional, and municipal buildings that are setting new standards in operating efficiency.
Despite their extra value, proved in every type of service, you pay no more for Jenkins Valves. For new installations, for all replacements, let the Jenkins Diamond be your guide to lasting valve economy. Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal.
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LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864
TRADE JENKINS MARK
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ANNOUNCEMENTS OBTAINED MOSTLY FROM ADVERTISERS IN MECHANICAL ENGINEERING AND ASME MECHANICAL CATALOG

# Keep Informed

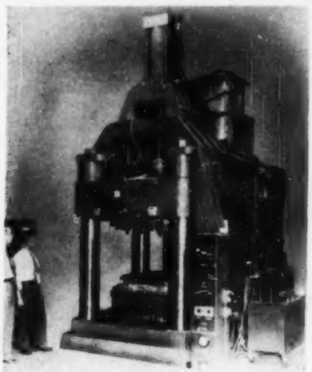
*New Equipment* *Business Notes* *Latest Catalogs*

Available literature or information may be secured by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as a source.

## *New Equipment*

### Injection Molding of Plastics

Complete refrigerator interiors, kitchen cabinets, and new-type fluorescent lighting fixtures molded in one piece from plastics may some day be rolling off production lines, it was forecast by General Electric chemical department officials. This predicted invasion of large plastics parts into the consumer and industrial field will be made possible by recent developments in injection molding presses, it was stated.



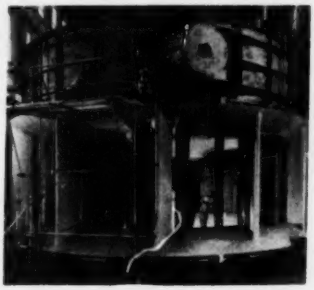
In anticipation of the coming trend for larger plastics parts made from thermoplastic materials, G-E has installed a J & C preplasticizing injection press manufactured by the Jackson and Church Co., Saginaw, Mich., at the G-E molding plant in Decatur, Ill., it was announced. Designed to produce plastics articles weighing up to 13 lb, the press can be easily converted to produce much larger items. It is now in production on large refrigerator components.

Weighing 135 tons and standing 27 ft in height, the J & C, 208-oz press incorporates a new patented mechanism that gives accurate control of pressure being applied in the mold. This feature permits close control of product quality, flexibility in product design, and broadens the potentialities for large plastics moldings.

Preplasticizing equipment on the press enables the coloring and molding of certain types of plastics in one operation. Capacity, with polystyrene, is rated at 1000 lb per hr on a continuing basis.

### Kaplan-Type Turbine

The fifth Kaplan propeller type hydraulic turbine for the TVA Pickwick Landing plant is undergoing assembly in the Allis-Chalmers erecting shop in Milwaukee, Wis. The pit liner, mounted above the stay ring, shows one of the two regulating cylinder supporting pockets. The wicket gates in open position and the inner head cover which supports the bearing can be seen through the



stay vanes. This turbine, one of the last two for Pickwick Landing, is rated 55,000 hp under 43-ft head at a speed of 81.8 rpm. Its cast-steel stay ring has an outside diameter of 37 ft 4 in., a height of 14 ft 4 in., and weighs about 225,000 lb.

The first two Pickwick Landing turbines built by Allis-Chalmers were put in operation in 1938 and two more were installed in 1942. The present two units will complete the number planned for this installation. They are still the largest in physical size in this country.

### New 21-in. TV Picture Tubes

Two new all-glass 21-in. rectangular TV picture tubes are now available from the Cathode-ray Tube Division of the Allen B. Du Mont Laboratories, Inc., Clifton, N. J. The new tubes offer several important advantages over previous 21-in. designs.

The new tubes are designated as the Type 21EP4A and the Type 21KP4A. Both types employ the same all-glass bulb which results in a picture area of 242 sq in., larger than previous metal-cone 21-in. tubes. The screen face is made of filter-glass for minimizing reflections and improving contrast.

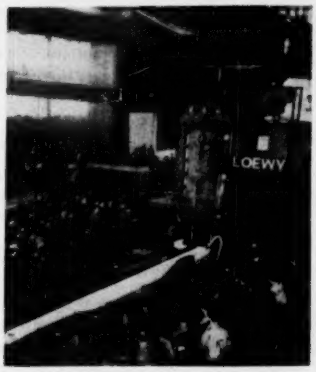
The Type 21EP4A employs the Du Mont bent-gun for electromagnetic focusing. A single-magnet ion trap is used. Type 21-KP4A is one of the new Du Mont Selfocus Teletrons requiring no focus controls or circuitry. It provides absolute focus at all times. The 21KP4A may be used as a replacement for either electromagnetic or electrostatic focusing type tubes.

### Hot Bloom and Slab Shear

An electrically operated hot bloom and slab shear designed by the Loewy Rolling Mill Division, Hydropress, Inc., New York, N. Y., has recently been placed in operation by the Alpine Montan Co. of Austria at their Donawitz plant. The shear operates in conjunction with a modern 44-in. blooming and slabbing mill and is capable of cutting hot blooms or slabs up to 16 × 16 in. or 40 × 6$^1/_2$ in. respectively, exerting a shearing force of 1150 tons.

Driven by two 300-hp electric motors this mechanically simple shear of the upcutting type operates from the standstill without flywheels or clutch. It is fully electrically controlled assuring high productivity and eliminating many common shearing troubles.

A variety of cutting speeds and an electrically adjustable knife opening combine to permit quick adaptation for the cutting of various sizes of material making the shear extremely versatile in operation.




The knives are fully supported along their entire length in a solidly constructed carrier eliminating any undue bending stresses caused by overhung load as is the case in other similar shears. The lower knife carrier is activated by a system of levers which is arranged in a manner to absorb all working stresses and leave the shear frame proper completely free of any stresses during the cutting operation. Positive control of the bloom or slab is accomplished by means of a spring-loaded hold-down which clamps the material tightly in place while cutting, and releases it as soon as the lower knife has descended sufficiently to let the material pass between the shear blades. With electrically operated push-off arms placed in front and back of the shear knives and allowing quick disposal of the crop ends, the shear is immediately ready for the next cut.

**Keep Informed** — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

The shear frame is designed in a manner to allow free access to all parts for inspection and maintenance, and in particular the open shear throat can be easily reached by the operator.

### Welding Machine

A new heavy-duty direct-current welding machine has been put on the market by the A. O. Smith Corp., Milwaukee, Wis. The machine is designed for all industrial uses, where d-c welding is required.

Extensive field testing has shown the new unit to be free of stack failure. This is accomplished by directing a high velocity downdraft of cool air over the rectifier stacks before passing this air through other parts of the machine. The blast is expelled at

the base of the A. O. Smith welder. This not only assures proper cooling, but promotes internal machine cleanliness.

The company retains in this d-c welder all of the principal construction features of its heavy-duty a-c welder. Among these features are the case-diameter fan and "wind-tunnel" design to assure adequate efficient air flow over all energized parts. The primary coils are raised and lowered easily on ball-bearing jacks. The machine is available in 200, 300, and 400 amp ratings.

### Bin-Level Indicator

A new, special model bin-level indicator which solves the problem of securing dependable level indication in large bins is announced by The Bin-Dicator Co., Detroit, Mich.

The new unit, known as Model CS Bin-Dicator, is designed for suspended installation from above and can therefore be located anywhere in the bin where there will be a free flow of material to and away from the diaphragm. This flexibility as to location permits the successful application of Model CS Bin-Dicator in bins containing materials which tend to build up on the walls of the bin and to flow down through the central area only. Under these and similar conditions,

indicators mounted on the bin wall couldn't function properly but the new Model CS Bin-Dicator, mounted in the area of moving material, gives dependable indication of high and low levels.

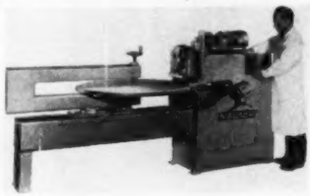
The unit is designed to be drilled and tapped to take any size pipe up to 2 in. The supported pipe also accommodates electrical wiring, making conduit unnecessary. Because of the manner of mounting, the installation can be easily moved up or down in the bin to operate at different levels or lifted out for inspection.

### Circle Shear

The Niagara Machine & Tool Works of Buffalo, N. Y., has just announced a new high-speed circle shear and flanger, especially designed for high production of disks and heads at a minimum tool investment. It is of interest particularly to manufacturers of tanks, drums, boilers, hot water heaters, containers, metal, furniture, and many other sheet-metal products.

It is ideally adapted for high production as well as low or even single quantity production. The setup can be changed from one size job to another in just a few minutes and conversion from circle cutting to flanging or vice versa can be accomplished in 20 or 30 min at most.

This machine will shear and flange a wide range of diameters and thicknesses of material. No blanking, forming, or drawing dies for the many different size heads are required.



As a Circle Shear it cuts at high speed circular disks or circular arcs of sheet metal up to 8-gage mild steel or 12-gage stainless steel. Disks 8 in. in diam to 58 in. in diam are produced from square blanks. Disks as large as $75^1/_2$ in. in diam can be cut from octagonal blanks.

As a Flanger it turns at high speed smooth, high flanges up to $1^1/_2$ in. deep from circular disks. The upper roll is moved down by power with speed adjustable to suit diameter and thickness of blank. Formed heads are true and round and free from irregularities and require no further trimming or finishing for average commercial work. Standard flanging rolls form a radius at the root of the flange of $^3/_8$ in., which is appropriate for materials within the capacity of the machine. Head diameters ranging from $18^1/_2$ to $73^1/_2$ in. are flanged with equal ease. Write for Bulletin No. 86.

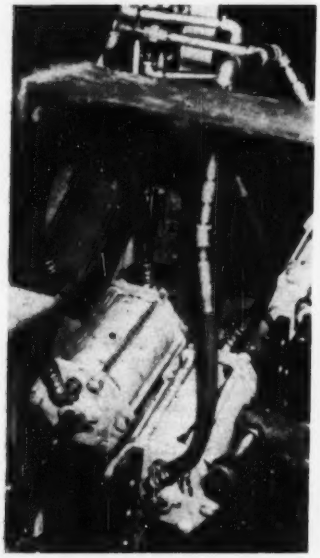
### Pneumatic Control System

To eliminate hard physical labor formerly required to operate a 20-year-old whirler crane, Southern Materials Co., Richmond, Va., installed a Westinghouse Air Brake Co. pneumatic control system recently. Air-powered actuators instead of a mechanical lever system now apply clutches and brakes on the boom, holding line, closing line, and cab brake.

The new controls were specified when the regular operator, a big man of exceptional strength, became ill and substitute operators of less weight and strength could not handle the crane satisfactorily. Formerly operated by a man in the standing position because his full weight was required on both foot pedals and the 4-ft hand levers, the crane is now readily handled by a seated operator. Maximum force on all pneumatic controls is 10 lb.

A 5-hp compressor delivers 80 lb air pressure to the actuators. On the operating levers a back pressure of 8 psi is used in lieu of springs for returning levers and pedals. On the foot-operated holding and closing line brakes a preload of 5 psi. is applied to give instant action and to minimize friction in the rigging or cylinders. These adjustments give the operator a better sense of "feel" and permit more accurate functioning of the equipment.

A safety feature of the new control system is the automatic application of brakes when and if the air supply pressure drops below 50 psi. This could occur in the event of a broken line in the main control system, compressor failure, excessive use of air, or other accidental cause.



The installation shows the simplicity of converting to this equipment since the pneumatic cylinders and controllers can be mounted almost anywhere in any position. Air lines may be located wherever space permits. This contrasts with the placement of mechanical linkages.

### Hydro-Blast Room

Sandblasters at the Falk Corp., Milwaukee, Wis., now do their work in an air-conditioned cab within a new Pangborn Hydro-Blast Room. The cab moves to any spot on three walls of the room and the operator directs an abrasive stream against the casting

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being cleaned. The ability of the abrasive stream to reach any casting surface; the elimination of heavy, cumbersome work clothes; and the increased capacity of the mechanically held hose, enable the operator to do more than three times as much work as he could previously. In addition, castings are cleaned more thoroughly.

The new Hydro-Blast Room replaces a conventional hydraulic sandblast system. Under the old method, the operator dressed from head to foot in rubber clothing and, in order to breathe, pulled along an air hose attached to the helmet of his cleaning suit. The usable capacity of the high-pressure blasting-hoses was limited by the operator's physical strength. The blasting job was so tiring that frequent rest periods were necessary. This method of knocking out cores and cleaning large castings was slow and costly. By eliminating many difficulties in the older method, the new system speeds the cleaning operation, reduces the cost of cleaning, and does better work.

The main parts of the Hydro-Blast system are the control car, a cleaning room, and the abrasives reclamation unit. The car is mounted on a carrier which moves along three sides of the cleaning room on a monorail. The car also moves vertically to give the cleaning-gun complete coverage of the work. The gun-nozzle has a capacity of 60 gpm at 2000 psi pressure. (The conventional capacity is 30 gpm at 1800 psi.) Turretlike action of the gun allows rotation through 60 deg horizontally and 50 deg vertically. By moving the carrier along the wall, the car up and down, and rotating the gun, the operator can direct the abrasive stream from an infinite number of points to cover all the surfaces and crevices of intricate castings.

### Down-Coiler Motor

A new heavy-duty, mill-type, flange-mounted down-coiler motor, designed to operate under some of the most severe conditions in steel-mill practice, is available from Westinghouse Electric Corp., Pittsburgh, Pa.

The new motor is equipped with a heavily-reinforced flange mounting; heavy-duty, double-row ball bearings; and heavy cast brass mill-type brushholders. It is of totally enclosed construction, with leads brought out through packing glands and protected by heavy hose.

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Armature construction uses slot wedges of class B material instead of bands, and windings with class B insulation for protection against hot spots resulting from high peak currents. The armature also has low inertia for rapid acceleration and deceleration. A bolted-type commutator assembled on a steel bushing is used for long life and ease of maintenance.

The relatively small diameter of this motor requires minimum mounting space. Flanges can be provided for mounting on any type of down-coiler.

### Nylon Setting Machine

A nylon setting machine which permanently sets nylon tricot fabric at a continuous rate of 16 yd or more per min has been developed by the McCreary Machine Works, Inc., Cohoes, N. Y., with the assistance of the General Electric Company's Industrial Heating Division.

Designed to be installed on existing tenter frames, the new machine consists of aluminum reflector units which house G-E Calrod tubular heaters. Automatic temperature control is provided by G-E Reactrol, an electronic temperature control unit which allows automatic stepless heat adjustment through thermocouples located in the reflector frames. Although 16 yd per min is the average machine speed, higher speeds can be accomplished by additional reflector units.

Operating costs are said to be less than $1 per hr. Compared with autoclave and other methods, it was pointed out, radiant heat setting requires only five instead of 10 steps and the width of the set fabric is constant. It was also pointed out that dyeing can be done either before or after setting, and that the radiant heat method is continuous instead of batch. Since the material is set while still on the tenter frame, extreme accuracy in dimension is obtained.

In operation, the operator sets the Reactrol temperature indicating controller to the predetermined setting temperature of the fabric, and pushes the button to start the tenter drive. The McCreary machine is electrically co-ordinated with the tenter drive to make the operation automatic. To prevent scorching, the reflector frames are designed to automatically raise if flow of fabric through the tenter frame stops.

### Drawing Instrument

A. W. Faber-Castell Pencil Co., Newark, N. J., announces a new and uniquely time-saving graphite lead drawing instrument, the Castell Locktite No. 9600 holder, with a specially imported Castell No. 9040 flat, very thin drawing lead.

This combination is said to permit the drawing of continuous straight lines of positive uniformity. Held firmly in patented internal sections, the imported Castell lead measures 0.017/0.018 in. in thickness × 0.096/0.098 in. in width, with a length of 4 in. It is available in degrees HB, F, H, 2H, 3H, 4H, 5H, 6H, 7H, 8H, and 9H.

Locktite 9600 is finding wide uses in drafting rooms, especially for lofting work and all types of designing and drafting where straight line drawing is essential. The fact that it never needs sharpening or sanding is another feature which is finding favor with professional pencil users.

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### Pencil Tracing Cloth

Engineers are now being offered a pencil cloth with new qualities permitting the use of a liquid eradicator to remove large pencil areas cleanly, quickly, and without disturbing the all-important tooth of the original cloth.

Good prints are assured by the extreme translucency providing a maximum contrast between pencil and the white background.

Write for free special demonstration kit for on-the-spot test proof to The Frederick Post Co., 3650 N. Avondale Ave., Chicago 18, Ill.

### Welding Coupling

A new product, the Tube-Turn SF (scale-free) Welding Coupling, now makes it possible to eliminate damaging welding scale from piping systems. Manufactured by Tube Turns, Inc., Louisville, Ky., the new welding coupling consists of two forged halves. The ends of the hubs are prepared for welding to pipe or welding fittings of corresponding sizes. When the two halves of the coupling are brought together, the tongue of one slips into the groove of the other. A circumferential cavity directly beneath the beveled welding area prevents burn-through or the formation of icicles in the interior. The cavity also insulates the interior from the extreme welding heat and prevents scaling.

Some of the advantages of the coupling are: (1) The tongue-and-groove arrangement makes piping easy to align; (2) the hubs of the coupling are relatively short and any scale or protrusions formed by the two attachment welds can be conveniently reached and removed before the coupling is connected; (3) there is no scale to damage valves, traps, pumps, etc.; (4) the coupling can be taken apart when piping is to be disassembled, and re-used; (5) the coupling joint is smooth, reducing pressure drop; (6) when properly welded the joint is permanently leakproof and as strong as the pipe itself.

### Small Synchronous Motor

A new small synchronous motor with unusual operating characteristics has been announced by Allis-Chalmers Mfg. Co., Milwaukee, Wis.

The motor, operating on the reluctance principle, has no brushes, slip rings, rotating coils, or permanent magnet. It can be built to operate continuously at any voltage below 250 volts, either single-phase or polyphase, and should interest designers of control systems, instrumentation, and military and industrial equipment.

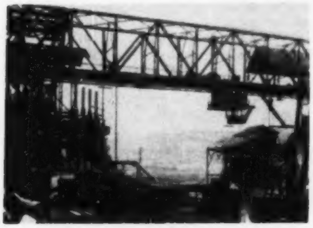
A typical motor is 4 in. in diam × $2^3/_8$ in. long, weighs 2.6 lb, and develops 8 oz-in. starting torque and 0.8 in. synchronous torque. Simplicity of construction provides high shock resistance and practically no maintenance.

No starting equipment is required, the motor being able to start and pull into step at any frequency from 10 to 400 cycles.

### Ore Bridge

A new ore bridge with a free digging stocking capacity of 1165 tons of ore per hr has been erected for Carrie Blast Furnaces 6 and 7 of United States Steel Company's Homestead District Works, near Pittsburgh. The structure, with a 186-ft span, has a bucket capacity of 15 tons and was designed to supplant two $7^1/_2$-ton ore bridges.

Dravo Corp. of Pittsburgh, Pa., fabricated the entire structure, except the main span which was built by American Bridge Co. The latter company also erected the new ore bridge which has an over-all weight in excess of 600 tons.



The bridge, running on rails, stockpiles ore from railroad cars and supplies ore to the conveying mechanisms which charges blast furnaces.

The main span of the bridge is supported on two legs, one of which is 80 ft high and the other 60 ft, from the runway to the bottom chord of the span. The shear leg, which is connected to the span by ball and socket joints to permit skewing of the bridge $^1/_{15}$ the distance of its length, is 70 ft wide at its base. The pier leg is 60 ft wide.

Each of the legs is supported on two 8-wheel truck units. A separate 45-hp electric motor drives each truck unit turning all 8 wheels through worm and spur gearing. The wheels are 27 in. in diam.

### Electronic Width Gage

Electronic eyes are the principal part of a new device, which for the first time will automatically and continuously measure the width of red-hot steel strips moving through rolling mills without physically contacting the metal. The device was developed in the General Electric Company's General Engineering Laboratory at Schenectady, N. Y.

Preliminary tests indicate that use of the gage will result in increased production of finished steel with less scrap loss.

Although the device has passed the developmental stage, no operating data is yet available. However, field tests will be made in the near future.

The new noncontacting gage can continuously measure, indicate, and record steel strip width by means of two electronic detectors mounted about 15 ft above the rolling-mill table.

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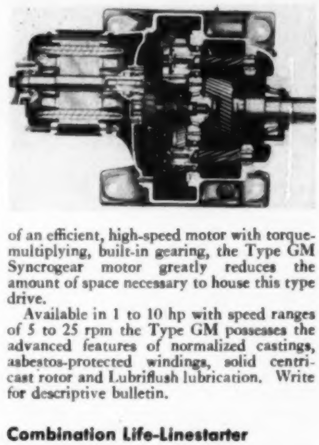
The electronic detectors, filling the role of eyes, "gaze" at edges of steel strips as they move under the gage. An optical lens, mounted in each detector, reflects the image of each edge of the strip. Necessary illumination for the reflecting image is furnished from the glowing strip.

The detector system converts the image of each strip edge into an electrical pulse signal. Both pulse signals are then automatically added together and can be recorded. Resultant chart readings can then give a continuous width record of all steel strips rolled. Any deviation from a preset desired width immediately shows on a "deviation indicator."

Vertical or sideways motion of the strip has little effect on accuracy of the gage.

### Triple Reduction Geared Motor

Through triple reduction gearing in their new Type GM Syncrogear, U. S. Electrical Motors, Inc., Los Angeles, Calif., now offer a high-torque low-speed motor capable of ratios up to 175:1. By the use of two secondary pinions driving the output gear, the effective torque rating is doubled. The load is distributed equally between the two pinions by a splined herringbone pinion. Consisting



of an efficient, high-speed motor with torque-multiplying, built-in gearing, the Type GM Syncrogear motor greatly reduces the amount of space necessary to house this type drive.

Available in 1 to 10 hp with speed ranges of 5 to 25 rpm the Type GM possesses the advanced features of normalized castings, asbestos-protected windings, solid centricast rotor and Lubriflush lubrication. Write for descriptive bulletin.

### Combination Life-Linestarter

A new combination across-the-line motor starter with fusible disconnect switch is available from Westinghouse Electric Corp., Pittsburgh, Pa., in NEMA sizes O through Z.

This starter, designated as Class 11-204-N, consists of a disconnect switch, main line fuse clips, and a Life-Linestarter mounted in a common enclosure. The disconnect switch is of an improved design, with visible blades and De-Ion arc quenchers. A self-indicating slamproof handle is provided in the cover. It has separate positions for on, off, and open cover, and can be locked in the off position by up to three separate padlocks.

Enclosures can be provided for general-purpose NEMA Type I, semidust-tight NEMA Type IA, dust-tight NEMA Type V, or NEMA Type XII to meet the JIC specifications of the mass-production industries. Starters are available for 3-phase operation, up to 600 volts, 60 cycles.

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### Tang Break Off-Tools

A complete new line of automatic tang break-off tools—for the removal of inserting tangs on helical-wire thread inserts—is now available from the Heli-Coil Corp. of Danbury, Conn. Operating on the principle of a spring-loaded center-punch, these tools remove tangs quickly without disturbing the inserts.

Fourteen standard models permit tang-removal operations at production rates on the following sizes and lengths of stainless-steel Heli-Coil thread inserts: 6–32 to $^1/_2$–13 sizes in the National Coarse thread series to lengths of 1, $1^1/_2$, and 2 diam; and 10–32 to $^1/_2$–20 sizes in the National Fine thread series to the same lengths. For other sizes and lengths of inserts, special punch assemblies (interchangeable with standard handles) can be supplied.

### Diesel-Powered Lift Truck

New Diesel power for the Yardlift-40 fork-lift is available from the Clark Equipment Co., Industrial Truck Division, Battle Creek, Mich. Primary purpose of offering Diesel power is to effect fuel-cost savings.

The engine, a model DIX-4D by Hercules, has a bore of $3^3/_8$ in. and a stroke of 4 in. Displacement is 166 in., giving 44 bhp at 1950 rpm. Maximum torque developed is 118 ft-lb.

Major specifications, such as $85^1/_2$ in. turning radius, over-all width of $41^3/_4$ in., length, etc., remain the same with the new engine as for the present Yardlift-40. The only operating changes will be the minor ones associated with Diesel operation.

Elimination of an ignition system reduces sparking dangers in areas of high inflammability—another advantage of Diesel power, though the new installation cannot take the place of a fully spark-proofed vehicle.

### A-C Aircraft Generators

A new line of 3-phase, a-c generators especially designed for aircraft will shortly go into production, the General Electric Company's Small and Medium Motors Department has announced.

Available in a variety of ratings from 15 to 90-kva at 120/208 volts, the generators have normal operating speeds ranging from 3800 to 8000 rpm and may be either "Y" or "delta" connected.

G-E engineers listed the following advantages for the new a-c generators: (1) Savings in weight up to 30 per cent can be realized when a-c generators are used instead of d-c generators. (2) Three hundred per cent short-circuit current rating provides a safety margin which insures operation of line clearing devices in event of electrical fault, thus giving positive short circuit protection. (3) Nearly perfect sine wave output of the a-c generators allows proper operation of electronic equipment demanding a low percentage of harmonics in the voltage wave form.

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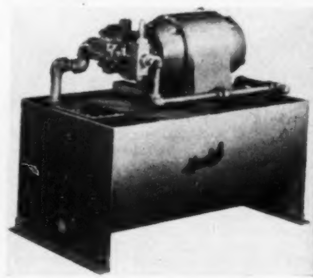
### Hydraulic Power Units

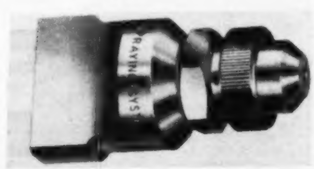
A complete line of hydraulic power units, combining reservoir, pump, and motor into a compact, practical, efficient unit is now in production at Haskell Engineering and Supply Co., Glendale, Calif. The line contains 224 standard models that are manufactured in three basic standard series: (1) Low-Pressure units which supply up to 1750 psi pressure and range from $1^1/_2$ to 50 gpm in single-pump models or to 100 gpm in double-pump models. (2) Hi-Low units which provide a dual pressure source by combining a high-pressure and low-pressure pump with automatic unloading of the low-pressure pump. These Hi-Low units provide rapid movement of a ram or cylinder, or quick



closure of the daylight opening stroke of a press, then automatically unload the high volume pump, still pumping a low volume at a high pressure for the work portion of the cylinder or press stroke. This automatic unloading feature reduces the power requirement by one half over a nonunloading system, and thus provides an efficient economical solution to the rapid closure problem. (3) Hi-Pressure units, supplying up to 10,000 psi pressure and ranging from $1^1/_2$ to 5 gpm in single-pump models and to 10 gpm in double-pump models.

### Pneumatic Atomizing Nozzle

Users of pneumatic atomizing nozzles will now be able to obtain nozzles of this type where the piping connected to the nozzle will be in line with the direction of spray. This new design, the $^1/_8$ JBC pneumatic atomizing nozzle, is of considerable importance in applications where space is limited and where the nozzle must be mounted in a projected position in relation to the part or material to be sprayed.



The $^1/_8$ JBC pneumatic atomizing nozzle is designed for use with all standard Spraying Systems fluid and air nozzle assemblies to meet a wide range of requirements in spray type, size, and volume. Assemblies available include both pressure and siphon setups, for producing round, flat, and wide-angle round sprays.

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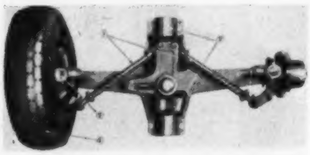
### New Steering Axle

An Elliott-type steering axle, designed for improved operating efficiency, is a new feature on the Yardlift-60 Fork-Lift Truck, product of the Clark Equipment Co., Battle Creek, Mich.

Torsional rubber bushings are used at both pivot mount points to absorb shocks that otherwise would be transmitted to the frame, resulting in easier riding and steering qualities. In addition, underclearance is increased over that of the old-type axle.

Added comfort, reduced operator fatigue, and increased efficiency result from use of the new axle, Clark declares.



The accompanying illustration shows (1) Relocation of tie rods—more nearly in line with forces they transmit. (2) Elimination of springs with new torsional rubber bushings at each pivot point. (3) Elliott type design bringing center of wheel closer to king pin and reducing road shock to axle. (4) Pneumatic tires as standard.

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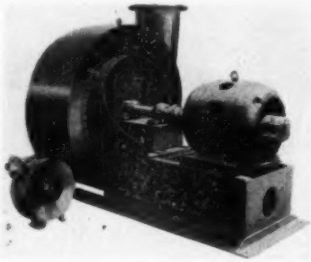
**Steel Blowers**

A new line of fabricated steel blowers of larger-than-ever capacity—limited in size only by available manufacturing space—is announced by the Billmyre Blower Division of Lamson Corp., Syracuse, N. Y. Standard models in the new line range up to 200 hp. Latest steel cutting and continuous welding methods have made the new designs possible. In addition to larger size, the new line offers weightsaving and space economy not heretofore feasible in cast blower construction. The same features of durability, simplicity, and efficiency are preserved.



Three styles are offered: the model SG (multistage) and the SM (single-stage) operating at 3500 rpm; the model ST operating at

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1750 rpm. Standard outlet pipe sizes run from 4 to 24 in.—all flange fitted. The smaller models (through 10 hp) are particularly useful for mezzanine or elevated mounting in either vertical or horizontal positions. Designed on a standard basis for air only, they can be adapted to the use of corrosive, poisonous, or explosive gases on special orders calling for stainless or sparkproof materials and special gasketing.

Blower outlets may be oriented in any of 14 positions depending upon the desired discharge angle and offset (from shaft centerline).

Delivered air pressures up to 3 psi (5.3 in. Hg) may be had.

### Corrosion Protection

There will be a minimum of underground corrosion of electrical lead sheathed cable, steel piping, and structural steel to interfere with full-time production at U. S. Steel's new Fairless Works at Morrisville, Pa.

To protect these metallic installations, bars of magnesium metal will be tied-in electrically with them and also will be buried adjacent to the big buildings in which steel will be made and shaped for the eastern market. This new cathodic protection was designed especially by the company's research engineers and engineers of the Construction Engineering Bureau after careful measurements, at Morrisville and in U. S. Steel's Research and Development Laboratory, of soil and water samples from the Fairless Works site.

Cable failures, burst pipes, and weakened structures cause considerable damage to commercial and industrial installations each year. In an effort to prevent such corrosion losses at the new mill an exhaustive study was made of probable electrolytic action underground and at the foundation level.

It has been found that when dissimilar metals are in electrical contact and are placed in a conductive liquid or moist earth a natural electrical current is generated between the metals and flows from one to the other. This current flows from the metal which by its nature corrodes most to that metal which corrodes least, causing the less stable metal to disintegrate or "decay." This is the principle of electrolysis on which flashlight batteries operate and, in reverse, which makes electroplating possible.

## Business Notes

### Garlock Consolidates Export Operations

The export operations of The Garlock Packing Co., manufacturer of mechanical packings, recently have been consolidated and the New York office has been made headquarters of this division. The division was moved to new offices at 30 Church St. in December.

The New York office will direct export operations for all parts of the world except distribution to the Phillipine Islands and the Hawaiian Islands, which will remain under the jurisdiction of Garlock's San Francisco office.

Mr. R. S. Parker was appointed manager of the Garlock Export Division, with headquarters in New York, at the time the consolidation was made.

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## U. S. Electrical Motors to Build New Plant

A $3,500,000 electrical motor manufacturing plant will be started in Orange County, Calif., in 1952 by U. S. Electrical Motors, Inc. Present U. S. Motors plants operate in Los Angeles and Milford, Conn. An 85-acre site midway between Anaheim and Buena Park, 20 miles from Los Angeles on Santa Ana Freeway, is being purchased. Construction will include a 50,000 sq ft administration building and 250,000 sq ft of covered manufacturing area.

## Johns-Manville Forms New Exploration Department

The formation of a new Exploration Department and a new Sales and Merchandise Department as part of Johns-Manville's expansion program in Canada was announced recently by Karl V. Lindell, vice president of Canadian Johns-Manville Company, Ltd., Asbestos, Que., and general manager of Asbestos Fibre Division.

George K. Foster, vice president of Canadian Johns-Manville, will head up the Exploration Department and John C. Kelleher, also a vice president of C. J-M, becomes sales and merchandise manager of the Asbestos Fibre Division.

"Although J-M production has increased more than tenfold in the past 35 years and the progress made at our Jeffrey and Munro Mine had added to our supply, we must continue to seek new sources of fiber to meet the intensified demand that we are reasonably certain will prevail in the future," Mr. Lindell said. "This element of our operations so affects the over-all activities of the company, and the function of exploration for new sources of fiber is of such major importance, that it is deemed necessary to make special provision for it."

## C. H. Wheeler and Economy Pumps Consolidate

The Economy Pump Div. of Hamilton-Thomas Corp., Hamilton, Ohio, is being consolidated with the C. H. Wheeler Mfg. Co., Philadelphia, Pa., another division of the corporation. Production, engineering, and sales departments of Economy are being moved from Hamilton, Ohio, to the Philadelphia plant. Economy Pumps will henceforth be known as Wheeler-Economy Pumps.

Economy Pumps Inc., started business in Chicago in 1914, supplying centrifugal pumps to the building trades. In the 20's the line was expanded to include nonclogging sewage pumps for municipal use. In 1938 the company acquired the plant of the Liberty Machine Tool Co. which was continued as an affiliate of Economy Pumps. With its expanded manufacturing facilties, a great many types of larger pumps were added to the line.

The C. H. Wheeler Mfg. Co. has contributed many of the outstanding developments in the field of vacuum products and condensing apparatus.

The Wheeler Co. succeeded the Barr Pump Co. which started business in 1887. The development of the Wheeler line paralleled the development of the steam-turbine generating unit.

In addition to its power plant, condenser, and vacuum-producing apparatus, the company manufactures marine condensers, deck machinery, cooling towers, and fine particle grinders for low micron and submicron process work.

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### B & W Tube Co. Dissolved

The Babcock & Wilcox Tube Co., a wholly owned subsidiary of The Babcock & Wilcox Co., New York, N. Y., was dissolved, effective at close of business Dec. 31, 1951. The Tube Company's business and assets will be absorbed by, and it will be operated as, one of the divisions of The Babcock & Wilcox Co.

The announcement, made jointly by the boards of directors of both companies, emphasized that the transfer of the plants and business of the Tube Company will have no effect upon its continued operation in so far as the customers and employees of the subsidiary are concerned and will not change The Babcock & Wilcox Co. stockholders' equities. The tube facilities will be operated as the Tubular Products Division of the company and Luke E. Sawyer and Edward A. Livingstone, Tube Company officers, will also become officers of The Babcock & Wilcox Co. The announcement said the change would be beneficial from an organizational and managerial standpoint.

The Babcock & Wilcox Tube Co. has its main offices at Beaver Falls, Pa., with plants at Beaver Falls and Alliance, Ohio.

### York Corp. Gets Ordnance Contract

A contract to manufacture breech rings for the U. S. Army 90-mm guns, and valued in excess of $1,000,000 has been awarded to York Corp.

The contract was granted the air conditioning and refrigeration firm by the Philadelphia Ordnance District of the U. S. Army for the Watervliet Arsenal located at Watervliet, N. Y.

The breech ring contract has been assigned to the Grantley Plant (York) and is expected to employ approximately 130 persons when actual production gets underway in 1952.

It was also announced that progress is being made in tooling up the production lines to start work on another contract to build rocket motors for the U. S. Navy. This line is expected to be in full production early in 1952.

### Warren to Open New District Office

Warren Steam Pump Co., Inc., Warren, Mass., announce that on and after January 1, 1952, all business formerly transacted through the office of Parkman A. Collins Co., 75 Federal St., Boston, Mass., will be handled by: Warren Steam Pump, Inc., 6 Leonard St., Belmont, Mass.

Mr. Parkman A. Collins has been appointed district manager in charge of the new office and Mr. Frank W. Amadon, Jr., formerly associated with Parkman A. Collins Co., will be a direct representative of Warren Steam Pump Co., Inc. Also, Mr. Philip J. Murdock, Jr., will continue to represent Warren in Northern New England.

### Refinery for Chile

Engineering has been initiated on Chile's first refinery, it was announced by The M. W. Kellogg Co., New York, N.Y. It will be located at a site about ten miles north of Valparaiso.

Kellogg, awarded the contract by Empresa Nacional Del Petroleo last month for the $10,000,000 refinery, estimates that actual construction will begin under the direction

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of its subsidiary, Kellogg Pan American Corp., in about a year. The refinery, a complete 20,000-bbl per day plant, will employ the most modern type of combination thermal processing equipment to produce several petroleum products from either indigenous or imported crude oils.

With the exception of special facilities for the preparation of liquefied petroleum gases, the refinery is quite similar—although larger in capacity—to one recently completed by Kellogg in Brazil. The New York firm is currently building two additional plants in Brazil, one having the same capacity of the completed unit and the other having a capacity approximately one half of the Chilean unit.

Products from the Valparaiso plant will include, aside from liquefied petroleum gases—motor gasoline, tractor gasoline, kerosene, two grades of Diesel oil, and heavy fuel oil. They will be moved to marketing points by both pipe line and truck.

Process facilities in the combination unit comprise crude-oil distillation, vis-breaking, thermal reforming, thermal cracking, gasoline stabilization and treating equipment for sulphur removal from fuel gas, liquefied petroleum gases, and gasoline. Kellogg will also design and engineer the power plant and all principal offsite facilities for the refinery.

## Latest Catalogs

### Axonometric Drawing

John R. Cassell Co., Inc., New York, N. Y., has acquired complete control of all patents and copyrights of the Instrumaster Line of Isometric and Dimetric Ellipse stencils and has prepared a new and complete booklet on this subject. For a free copy, address John R. Cassell Co., Inc., 110 West 42 St., New York 18, N. Y.

### Open-Steel Grating

The William F. Klemp Co., 6629 South Melvina Ave., Chicago 38, Ill., announces availability of an entirely new 1951 technical manual, explaining in a concise manner the properties of its structural steel footwalks, its power-forged and riveted open-steel grating and treads, Hexteel heavy duty surface armor, the ganister lining reinforcement meshes, Floorsteel flexible floor armor, open steel and aluminum bridge decking and Flexteel flexible open steel conveyor belt.

Write for AIA File No. 14P-P-21.

### Induction Heating

A new 12-page booklet, No. B-4782, on induction heating is available from Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa. The booklet presents case histories of how induction heating has increased production 50 to 2000 per cent, reduced space up to 90 per cent, and cut production costs. It tells how batch handling can be changed to in-line production methods, and how—in one case—an induction heating machine handles 432 different parts. Modern induction heating apparatus—generators and work-handling equipment—are described as "machine tools" for hardening, heating, annealing, or joining metals in mass or batch quantities.

Keep Informed

NEW EQUIPMENT
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**Nickel Alloy Steels**

A 24-page bulletin, with 11 tables and 7 detailed drawings, that will assist the user of nickel alloy steels in determining the most economical and satisfactory combination of microstructure, tool form, cutting speed, rate of feed, etc., for each type of machining operation is available from International Nickel Co., Dept. EZ, New York 5, N. Y. It is shown that the manner in which a given steel responds to the usual machining operations is determined by the microstructure rather than by chemical composition. Low, medium, and high carbon alloy steels are compared as to machinability in different operations when treated to obtain similar types of microstructure. Turning, broaching, drilling, tapping and threading, milling, and drawing are discussed.

**Hand Trucks and Stackers**

A new 16-page bulletin, No. P809, describing the application, types, and operation features of the Yale line of motorized hand trucks and electric stackers has been released by the Philadelphia, Pa., Division, Yale & Towne Mfg. Co. Known as the Yale Worksaver line, these "ride-'em or walk-'em" industrial trucks are available in capacities up to 6000 lb and are designed for applications where high maneuverability is desired. They are particularly suitable for areas where floor capacities preclude the use of sit-down-type trucks, but where the cost-saving advantages of mechanized handling are desired. A special section shows the various attachments available for the Worksavers that permit handling of a wide range of objects without pallets.

**TEFC Motors**

Construction details of totally enclosed, fan-cooled motor (Type APZ) are described in a new bulletin, No. 51B7225, released by Allis-Chalmers Mfg. Co., Milwaukee, Wis. Due to the elimination of internal air passages and dirt-catching pockets, the motor is easy to keep clean. This feature, together with an efficient cooling system, makes the motor suitable for use where there is dust, dirt, fly ash, rain, snow, or corrosive gases. Construction features of the motor, which can be mounted anywhere, include a rigid cast iron frame which resists corrosion and holds bearings permanently in alignment, double insulated stator, improved heat dispersal, die cast rotor, rotating seals on both ends of motor, double-shielded bearings, ribbed end shields, and roomy conduit box.

**Valves**

The Cooper Alloy Foundry Co., Hillside, N. J., announces availability of an 8-page booklet entitled, "How to get What You Need When You Order a Valve." It describes many of the peculiarities encountered in the relationship between companies and suppliers of the equipment they use, notably the lack of agreement on data to be disclosed in placing orders or bid invitations. Information necessary to enable the manufacturer, supply company, or sales representative to fit the proper valve for the application at hand, is discussed in detail. This includes: Data required when ordering manually operated valves, power-operated valves, instrument-operated valves, pressure and temperature regulators, traps and level controllers, relief valves, and check valves.

## Keep Informed

NEW EQUIPMENT
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### Product Design

A 16-page catalog prepared especially for product designers' use has been published by Chicago Metal Hose Corp., Maywood, Ill. This catalog was prepared to give complete description and specifications of the many products manufactured by Chicago Metal Hose Corp. for original equipment manufacturers' use. It is designed for quick reference and ready access to pertinent information. Information on metallic bellows of stainless steel, brass, bronze, and other alloys is included. Complete specifications giving the pertinent characteristics of the complete size range of these bellows which are used extensively in many types of control, regulators, and thermostatic devices are given. For applications such as steam traps, instruments, valves, shaft seals, and many others, a guide to the proper selection can be obtained from this bulletin. Also included is complete information on the company's several types of flexible metal hose and tubing. Data on flanges, couplings, and fittings as well as complete information data makes this catalog a complete treatise on the company's products available for use in the manufacture of many products.

### Hydraulic Cylinders

A new Catalog Section, No. 105, published by Rivett Lathe & Grinder, Inc., Boston, Mass., illustrates and describes 108 different models of hydraulic cylinders, each in ten bore diameters. The catalog offers to designers a complete file on hydraulic cylinders. The book lists every standard hydraulic cylinder offered in the industry. Working drawings and specifications are furnished for each model and size cylinder, both standard and cushioned types, standard rod and 2:1 over-size rod, single and double-end rods, internal and external threads. All information relative to a particular model is shown on one page, facilitating easier layout of circuits by the engineer. Cylinder mountings described are rabett foot, trunnion, center line, blind end flange, rod end flange, and clevis, in 2 to 10-in-bore diam, with strokes up to 96 in.

### Steam Heating System Controls

A group of five bulletins issued by Warren Webster & Co., Camden, N. J., give complete information on Webster moderator control systems and equipment including (1) electronic pressure differential control system for continuous steam flow embodying metering orifices, automatic outdoor thermostat, manual adjustments for scheduled control, and automatic equipment for pressure difference control; (2) pulsating flow control embodying metering orifices, automatic outdoor thermostat and manual adjustments for scheduled control, fixed time cycle with automatic variation of "on" interval; (3) motor-operated throttling type main steam control valve in $1^1/_4$ to 12-in. sizes; (4) motor-operated valves for shut-off service; (5) ten principal types of metering orifices for use in moderator system.

### Hand Trucks

A 12-page condensed truck catalog (Form 508-B) is available from the Howe Scale Co., Rutland, Vt. Specifications and illustrations are shown for the complete line of the latest Howe two and four-wheel hand trucks, trailer trucks, baggage wagons, platform skids, dollies, lift jack systems, wheels, casters, and molded-on rubber tired wheels.

## Keep Informed

NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

### Airless Rotoblast Room

The Pangborn Corp., Hagerstown, Md., announces a new four-page, two-color, 8 × 10-in. brochure, No. 222, on its Airless Rotoblast Room. The Airless Rotoblast Room is a completely enclosed chamber in which large castings are cleaned by streams of centrifugally hurled abrasives.

Including two photographs, three line drawings, and three plan and elevation drawings, the bulletin explains how the Airless Rotoblast Room reduces cleaning time by two thirds, cuts labor costs, improves cleaning quality, and makes the operator's job easier. Previously the airless blast cleaning technique was confined to small castings.

### Electronic Contour Follower

A new four-page bulletin No. GEA-5660 on electronic contour follower systems for machining irregularly shaped parts is available from the General Electric Co., Schenectady 5, N. Y.

The publication covers one, two, and three-dimension tracer control systems for use on lathes, boring mills, milling machines, drilling machines, etc. Employing many photographs and diagrams it gives a brief description of each of the systems, its components, features, and operation.

### Photoelastic Stress Analysis

Eastman Kodak Co., Rochester, N. Y., announces that a new and up-to-date edition of "Photoelastic Stress Analysis" is now available through Kodak dealers. This new booklet, like the old, begins by pointing out that photoelastic stress analysis is one of the most effective methods available to the engineer for solving problems of stress distribution. It discusses briefly other methods of stress analysis and then launches into a discussion of the principles of photoelasticity. This section covers polarized light, double refraction or birefringence, isochromatic lines, isoclinic lines, circular polarization, and stress patterns. The booklet also discusses apparatus for the production of photoelastic stress analysis including light sources, filters, polarizers, analyzers, quarterwave plates, condensers, and the camera.

"Photoelastic Stress Analysis" is illustrated in both black-and-white and color with numerous pictures and diagrams. It sells for 35 cents a copy and will be available through Kodak dealers.

### Wet-Pit Freeflo Pumps

A new bulletin, No. W-317-B12, describing Freeflo pumps for sump, sewage, and drainage service, has been announced by Worthington Pump and Machinery Corp., Harrison, N. J. The manufacturer describes its FLJ and FLJD wet-pit pumps as having nonclogging sewage pump impellers capable of passing solids and stringy material. Unlike most designs of wet-pit nonclogging pumps, these pumps have a stuffing box above the impeller and the pump bearings are above and separate from the box. As the stuffing box is normally inaccessible, it is equipped with U-cup packing which requires no adjustment and which has proved its success in vertical turbine pumps handling sandy water. Bulletin includes a cross-section drawing, graph of coverage for 60-cycle motor speeds, dimensions in inches and data on flanges. Available by request on company letterhead.

Keep Informed

NEW EQUIPMENT
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### Water Columns

Bulletin No. WG-1811 (1951) issued by Yarnall-Waring Co., Philadelphia, Pa., on steam plant equipment, replaces the 1948 edition. Important improvements have been made in the flat-glass inserts used in Yarway high-pressure gages. These features are described on pages 8–9. The pressure-sealed floating-assembly design plus nonstick gaskets has helped to solve a great many service problems in high-pressure boiler operation and the new Type M illuminator with its mercury vapor lamp is a big step towards improved visibility of the meniscus.

### Roller Chains

Baldwin-Rex double pitch roller chains are pictured and described in detail in a new bulletin, No. 51-2, released by Chain Belt Co. of Milwaukee, Wis. How these chains can often effect both cost and weight reductions in drives and conveyers is described. Charts, photos, diagrams, and tables show in detail all Baldwin-Rex double pitch roller chains—both drive and conveyer types—and the standard attachments available. There is also a description of double pitch chain sprockets.

### Pipe-Line Strainers

Several types of pipe-line strainers for all purposes ranging in sizes from $^1/_2$ to 36 in., some of which embody new concepts of design and function for making continuous production processes possible, are described and illustrated in a new pipe line strainer data manual, No. 951, available from J. A. Zurn Mfg. Co., Erie, Pa. Summarizing important developments resulting from Zurn continuous engineering research in fluid handling equipment, this illustrated manual carries information on the factors to consider in selecting type and size of strainer for a specific application, and the effect of flow rate, screen loading, and the viscosity of fluid on pressure drop.

### Condenser and Heat Exchanger Tubes

A new and expanded edition, No. B-2, of "Anaconda Tubes and Plates for Condensers and Heat Exchangers" has been announced by The American Brass Co., Waterbury 20, Conn. It was written especially for use by engineers responsible for the selection of materials in the marine, oil refining, and stationary steam power plants. This 44-page booklet discusses the application and installation of condenser and heat exchanger tubes, also plates for tube sheets, heads and baffles. Two new subjects have been introduced in this edition: "Operational Factors Affecting Tube Life" and "Corrosion Factors in Condenser Tube Service."

### Oil and Grease Seals

Complete information on the company's Klozure oil and grease seals for bearings is available in a 100-page catalog just published by The Garlock Packing Co., Palmyra, N. Y. The catalog contains illustrations of all types of Klozures, typical applications, and a complete list of sizes and part numbers. In addition, this catalog describes in detail Garlock's mechanical pressure seals for rotary shafts. Copies of Klozure catalog No. 10 are available from the company upon request.

## Keep Informed

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

### Fork-Lift Trucks

Using a unique system of visual cross reference charts, a new condensed catalog offered by the Industrial Truck Div. of Clark Equipment Co., Battle Creek, Mich., makes all essential model and attachment information available at a glance. Broken down, page by page, the catalog shows specifications by model and capacity for both gas and electric fork-lifts with cushion-type tires and pneumatic tires. Similar treatment is given to Clark towing tractors and the new powered hand trucks, hand pallet trucks, hand platform trucks, and hand stackers. Another timesaving feature of the catalog is an attachments-and-devices cross-reference page, which quickly shows all attachments and devices, and to which Clark truck models these have been adapted.

### Motor-Driven Pumps

A new bulletin, No. 251, on Milton Roy motor-driven controlled volume pumps has been published recently by Milton Roy Co., 1300 East Mermaid Lane, Philadelphia 18, Pa. This 24-page, 2-color, illustrated bulletin will be of interest to anyone faced with the need of pumping practically any liquid, from heavy viscous liquids to light solvents, solids in suspension, abrasive slurries, hot or cold liquids, liquefied gases, and other materials. Illustrated and described are standard Milton Roy motor-driven controlled volume pumps as well as models designed for special applications.

### Full Line Catalog

Westinghouse Sturtevant has just published a 16-page, condensed full-line catalog. Equipment for air conditioning, for air handling, and for air cleaning is described in considerable detail.

Under air-conditioning equipment will be found: unit air conditioners, unit heaters, home electronic air cleaners, hermetically sealed compressors, and condensers and water coolers.

The air-handling apparatus section includes: ventilating equipment, air-conditioning equipment, heating equipment, general-purpose and industrial fans, and heavy-duty and mechanical-draft fans.

The third section includes: Precipitron—principal of operation, home air cleaners, horizontal air cleaner, vertical air cleaner, and oil mist control unit.

For a copy of Booklet B-5164, write Department T, Sturtevant Div., Westinghouse Electric Corp., Hyde Park, Boston 36, Mass.

### Power Plant Coal Handling

A new 44-page book No. 2410 on coal and ash-handling equipment for power plants is available from Link-Belt Co., Chicago, Ill. The book contains helpful layout drawings and interesting photographs of actual installations. The pictures include installations at both large and small public utility, industrial, and public building power plants. They show installations at new power plants as well as boiler houses that were modernized, enlarged, or improved after the original installation. There are sections in the book on unloading coal, auxiliary unloading, coal storage and reclaiming, crushers, transporting and distributing equipment, ash handling, and water intake screens.

## Keep Informed — *New Equipment* | *Business Notes* | *Latest Catalogs*

### Cast Alloy Tools

Machinists, metallurgists, and tool designers will find much useful data on cast alloy metal-cutting tools in a new 44-page tool manual and catalog just published by Haynes Stellite Co., a Division of Union Carbide and Carbon Corp., New York, N. Y. Entitled, "Haynes Stellite Metal-Cutting Tools," the booklet describes four different grades of cast cutting tool alloys: Haynes Stellite alloys Nos. 19 and 3, Star J-Metal, and 98M2 alloy. It gives the physical, mechanical, and chemical properties of these alloys to help in selecting the right tool alloy for various cutting operations. A brief general description of chip formation and tool design, and their effects on tool life, is also included.

### Vane Type Rotary Pump

Bulletin No. W-485-B1 on a new heavy-duty vane-type rotary pump has been announced by Worthington Pump and Machinery Corp., Harrison, N. J. The 4-page bulletin pictures and describes the six models of the pump in 8 sizes. They include pipe openings from 2 to 12 suction in., and 2 to 10 discharge in. The range of nominal ratings includes capacities from 25 to 1000 gpm and speeds from 850 to 210 rpm. Dimensions, nominal ratings, and line drawings of the pumps are also included. Available by request on company letterhead.

### Hydraulic Systems Filters

Complete engineering data on synclinal-type filters for sump or line installation on all hydraulic and low-pressure liquid recirculating systems is contained in folder No. 105 recently published by the Marvel Engineering Co., 625 West Jackson Blvd., Chicago 6, Ill. Single unit capacity sizes available from 5 to 100 gpm. Choice of filter mesh from 30 to 200.

### Forge Plant

The drama surrounding men who turn out thousands of forgings for "America's guns and butter" program is strikingly brought out by "This is Kropp," a 24-page photographic study of the workers of Kropp Forge Company, Chicago, Ill. This booklet, designed to photographically tell the human side of one of America's largest forging plants, is available free of charge to all readers.

### Hydraulic Remote Controls

The new line of Sperry hydraulic remote controls are described generally in bulletin No. 20-106 released by Sperry Products, Inc., Danbury, Conn. The Sperry hydraulic controls are the only single tube, balanced, self-contained system operating independently without outside sources of power. These hydraulic controls have a maximum rated capacity of 400 in-lb on the pressure stroke and 125 in-lb on the return stroke.

### Maxitorq Clutch

The Carlyle Johnson Machine Co., Manchester, Conn., offers to machine and product design engineers the new 1951 edition of the Maxitorq catalog. Pictured and described, with engineering drawings and specifications, are the standard floating-disk clutches in 8 sizes from $^1/_4$ to 15 hp at 100 rpm and the Maxitorq automatic overload release clutch. Included also are special driving cups for pulley-type, cut-off coupling, and ring-type installations. A special feature is the nonlocking lever, which prevents the clutch from being locked into engagement when used with foot pedal operation or for rapid traverse operations.

### Fusion Welding of Nickel

A new, 44-page booklet, No. T-2, on the fusion welding of nickel and the high nickel alloys has been published by the International Nickel Co., Inc., New York, N. Y. It contains 44 pages and includes more than 30 tables and almost 50 drawings and photographic illustrations. A complete technical treatise on the subject, it covers various forms of electric arc welding as well as gas welding. There are over 20 chapters and sections covering, in addition to detailed welding instructions, such information of importance to production and welding engineers as the ASME Boiler Code, pickling, testing, and inspection safety methods, and associated topics.

# Intermediates that last like photographs

**. . . produced at low cost**

*A case history based on the experience of the Hyster Company, Portland, Oregon*

**By reproducing its engineering drawings on Kodagraph Autopositive Paper,** the Hyster Company gets intermediates which have dense black photographic lines on a translucent, highly durable paper base. *Intermediates* which will remain intact in the files year after year . . . and produce sharp, legible blueprints and direct-process prints whenever needed.

**And the cost is surprisingly low** because Kodagraph Autopositive Paper boasts unique photographic properties which cut production costs *substantially*. It can be handled in ordinary room light . . . and it produces positive copies *directly*—without a negative step.

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***How The Hyster Company Uses Autopositive***

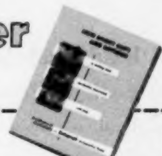
**For All Print Production.** Autopositive intermediates are used instead of valuable and perishable original drawings. Producing sharp, legible blueprints and direct-process prints time after time, they greatly reduce the possibility of reading errors in the shop.

**For "Permanent" Files** in its home office . . . and branches in the United States and abroad. "Photolasting" Autopositive intermediates eliminate the costly delays experienced in the past when intermediates faded, turned yellow, or became brittle.

**For Drafting Room Short Cuts.** Autopositive Paper is used to reclaim old and weak-lined drawings . . . and to duplicate standard designs which will be incorporated in new drawings. *All of which saves hours of creative drafting time.*

## Kodagraph Autopositive Paper

**"THE BIG NEW PLUS" in engineering drawing reproduction**



**Learn in detail** all the ways you can use Kodagraph Autopositive Paper — the revolutionary photographic intermediate material which you, or your local blueprinter, can process *quickly . . . economically . . . at a low cost.*

**EASTMAN KODAK COMPANY**
**Industrial Photographic Division, Rochester 4, N. Y.**

16

Gentlemen: Please send me a copy of "New Short Cuts and Savings" . . . describing the many savings Kodagraph Autopositive Paper is bringing to industry.

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Kodak
TRADE-MARK

# Only Edward Offers Streamlined Flow

## From 1/4" to 16"....Edward Gives You Streamlined Flow in Globe, Angle, Check, Non-Return, Blow-Off, Gate and Feed Line Valves...in Cast and Forged Steel!

In today's trend to higher pressures and temperatures, with resulting increased erosion, streamlined flow plays an even bigger role in keeping valve operating and maintenance costs down . . . and system efficiency high.

Pioneered by Edward—developed after years of extensive flow tests and experiments with plastic models, prototypes, and much specially designed equipment in the largest laboratory in the world devoted exclusively to steel valve research—Edward *Streamlined Flow* offers these four outstanding advantages.

1. **Reduces wear-producing turbulence—giving longer life to seat, disk, and other moving parts.**
2. **Lower pressure drop.**
3. **Delivers maximum flow where needed.**
4. **Often permits use of smaller pipe and valve sizes.**

With Edward's broad range of valve sizes and types with streamlined flow, you can get peak valve operating efficiency . . . all-across-the-board, *wherever* valves are used. *A product of* Edward Valves, Inc., 1350 West 145th Street, East Chicago, Indiana.


Edward ...BIRTHPLACE OF BETTER VALVE DESIGNS


—IN A FULL RANGE OF VALVE SIZES
These illustrations show wear-reducing Edward streamlined flow in both small and large valves. Small valve demonstrates straight through, full flow channel of Edward Univalve. Large valve is Edward globe stop valve . . . note smooth, economical flow pattern.
EDWA
FEATURES LIKE THIS SAVE YOU MONEY
That's why it pays to specify Edward Valves
Another Product
Edward Valves, Inc.
Subsidiary of ROCKWELL MANUFACTURING COMPANY
EAST CHICAGO, INDIANA





# Multi-Purpose Thermostat helps solve heat-control problem in Bede Paint Heater

**BEDE PAINT HEATERS,** used to speed up paint spraying and save material by heating both paint and air, rely on Fenwal Block Head THERMOSWITCH Unit installed in explosion-proof heating block.

When Bede Products, Inc. originally designed the Bede Paint Heater it faced a primary problem: safety.

Underwriters' Laboratories, Inc. cautioned against the danger of electrical heating in paint spraying areas. So a metal block with pipes for paint and air was made explosion-proof by a special surface cover and fittings. The temperature control unit, which had to be compact, economical and accurate, could then be located in the block, flanked by heating elements.

### LOW-COST SOLUTION

A Fenwal THERMOSWITCH Unit — 8/10 of an inch in diameter — met all specifications: low cost, precise performance, compact size, high current-carrying capacity. By this, it enables Bede Paint Heaters to lower the cost of paint spraying throughout industry.

### YOUR PROBLEM?

Many types of control problems can be solved by easy-to-install, easy-to-maintain Fenwal THERMOSWITCH thermostats. Their activating control element is the single-metal shell that expands or contracts *instantaneously* with temperature changes, making or breaking the totally enclosed electrical contacts. Through this unique principle, THERMOSWITCH Units effectively control *many* variables where heat is a factor.

Find out now how Fenwal THERMOSWITCH Units can help you in *your* product. Mail coupon today.

**Fenwal**

**THERMOSWITCH**

The Precision Multi-Purpose Thermostat Control

SENSITIVE ... *but only to heat*

**FREE!** Get this bulletin . . . see what Fenwal THERMOSWITCH Units can do for you. *Just fill in coupon and mail . . . no obligation.*

FENWAL INCORPORATED, 51 Pleasant St., Ashland, Mass.
Los Angeles, Cal.

TEMPERATURE CONTROL ENGINEERS

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City .................................... Zone ........ State ....................

I am chiefly interested in the applications checked:

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- ☐ Cooling
- ☐ Humidity Control or Detection
- ☐ Alarm (over-temperature, under-temperature)
- ☐ Vapor Control
- ☐ Timing (thermal)
- ☐ Radiant Heat Control
- ☐ Pressure Control (by controlling vapor temperature)

OTHER (Please fill in your special requirements) ........

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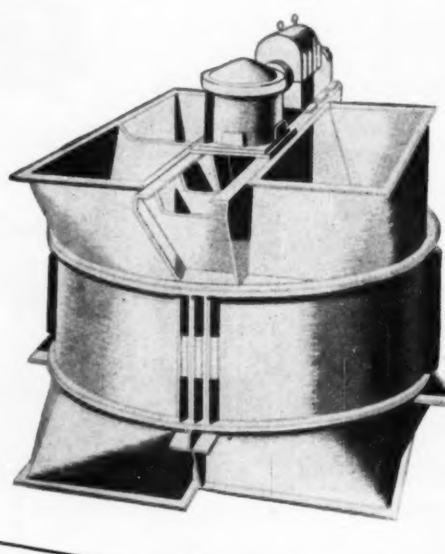
# this preheater is cutting fuel costs in hundreds of plants!

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.



The Ljungstrom air preheater has proved its value in industrial and utility plants throughout the country. That is why every year a constantly increasing percentage of the installed boiler capacity is equipped with Ljungstrom air preheaters.

*Your* fuel costs will be lower too, when your boiler is equipped with the Ljungstrom air preheater. The regenerative design of the Ljungstrom permits reliable operation at low exit gas temperatures. This assures the greatest possible heat recovery . . . reduces the amount of fuel required.

If you are planning a new installation, or expanding your present one, our engineers will welcome the opportunity to show you how the Ljungstrom air preheater can raise the overall efficiency of *your* plant.

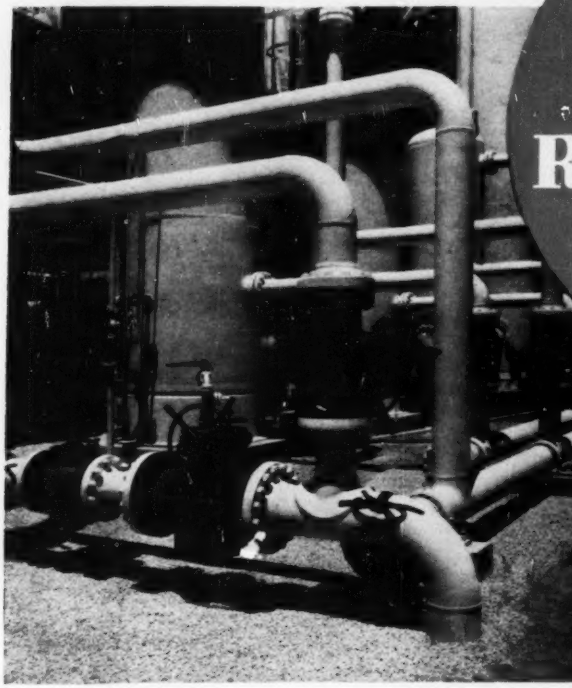
## THE AIR PREHEATER CORPORATION

**60 East 42nd Street, New York 17, N. Y.**


TERRY
FIVE STEPS . . .
in making an
almost indestructible
TURBINE
The rotor of a Terry Solid-wheel Turbine is a single forging of special composition steel. It is first rough turned in two operations, as illustrated, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. The result is a single-piece wheel with no parts to loosen or work out.
As the only function of the blades is to form a series of pockets, wear of the blades is of little consequence and does not materially affect the horsepower or efficiency. The important part of the bucket is the back, or bottom, which is a solid forging.
It is impossible for the blades to foul. They have large clearances, and are further protected by the projecting rims at the sides of the wheel. As the side clearances are also very large, end play can do no harm.
The Terry Solid-wheel Turbine is an extremely reliable piece of equipment. Why not write for complete details today?
THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.
TT-1188
Memo
Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

# *Grinnell Welding Fittings for*

# MINIMUM RESISTANCE TO FLOW



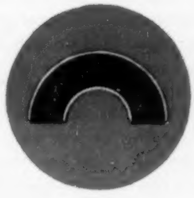
Grinnell Welding Fittings on towers of natural gasoline plant.

**TRUE CIRCULAR SECTION**

**True circular section at all points makes a Grinnell fitting easy to align and weld . . . no distortion or flattening to affect flow adversely.**

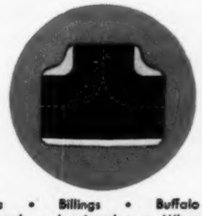
**FULL EFFECTIVE RADIUS**

**Pressure loss through Grinnell welding elbows is held to a minimum because of the full, effective sweep of the radius.**



**SMOOTH, CLEAN INSIDE SURFACE**

**Grinnell fittings have uniformly smooth inner walls . . . no waves or ridges to cause turbulence or accelerate erosion or corrosion. No pockets to trap solids or foreign matter.**



**EASY, SWEEPING TURNS**

**In Grinnell welding tees, the corners where the outlet joins the run are well-rounded and perfectly smooth to minimize resistance to flow and to prevent trapping.**

Any qualified welder can make welds quickly and easily with Grinnell welding fittings. These fittings are made by a hydraulic forging process that assures uniform wall thickness at all points and true circularity throughout. Of seamless, one-piece construction, they can be cut at any angle to match up with standard weight, extra strong and heavier wall pipe in I. D. or O. D. sizes. Pressure-temperature ratings are equal to or greater than those of seamless steel pipe. Grinnell welding fittings are process stress-relieved.


Full data on the complete line of Grinnell carbon steel butt welding fittings and forged steel flanges is contained in the Grinnell Welding Fittings Catalog.

SEND FOR THIS CATALOG

# GRINNELL

**WHENEVER PIPING IS INVOLVED**

**GRINNELL COMPANY, INC., Providence, R. I. Warehouses: Atlanta • Billings • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach • Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane**

# OILITE

# CAN HELP YOU NOW

Oilite Finished Machine Parts — with **NO** Machining

## *Here's how:*

Oilite finished machine parts provide dependable replacements for bronze, brass, aluminum, cast iron, steel, and plastics. Frequently, replacements are permanent.

**Oilite Material**

Many Oilite raw materials, i.e., metal powders, are produced from by-products, readily available.

**Tooling**

Using Oilite finished machine parts, you save

- Tooling programs
- Tool Design
- Machine Tools
- Jigs and Fixtures
- Cutting Tools
- Gages
- Floor Space
- Skilled Manhours

Amplex type tools are, by comparison, inexpensive. Tool and die making facilities are available.

**Delivery**

Making Amplex tools generally requires only days or weeks and no additional machines.

**Case Histories**

Under conditions like today's we were in quantity production within six (6) weeks or less compared to eighteen (18) months by other processing.

**Service**

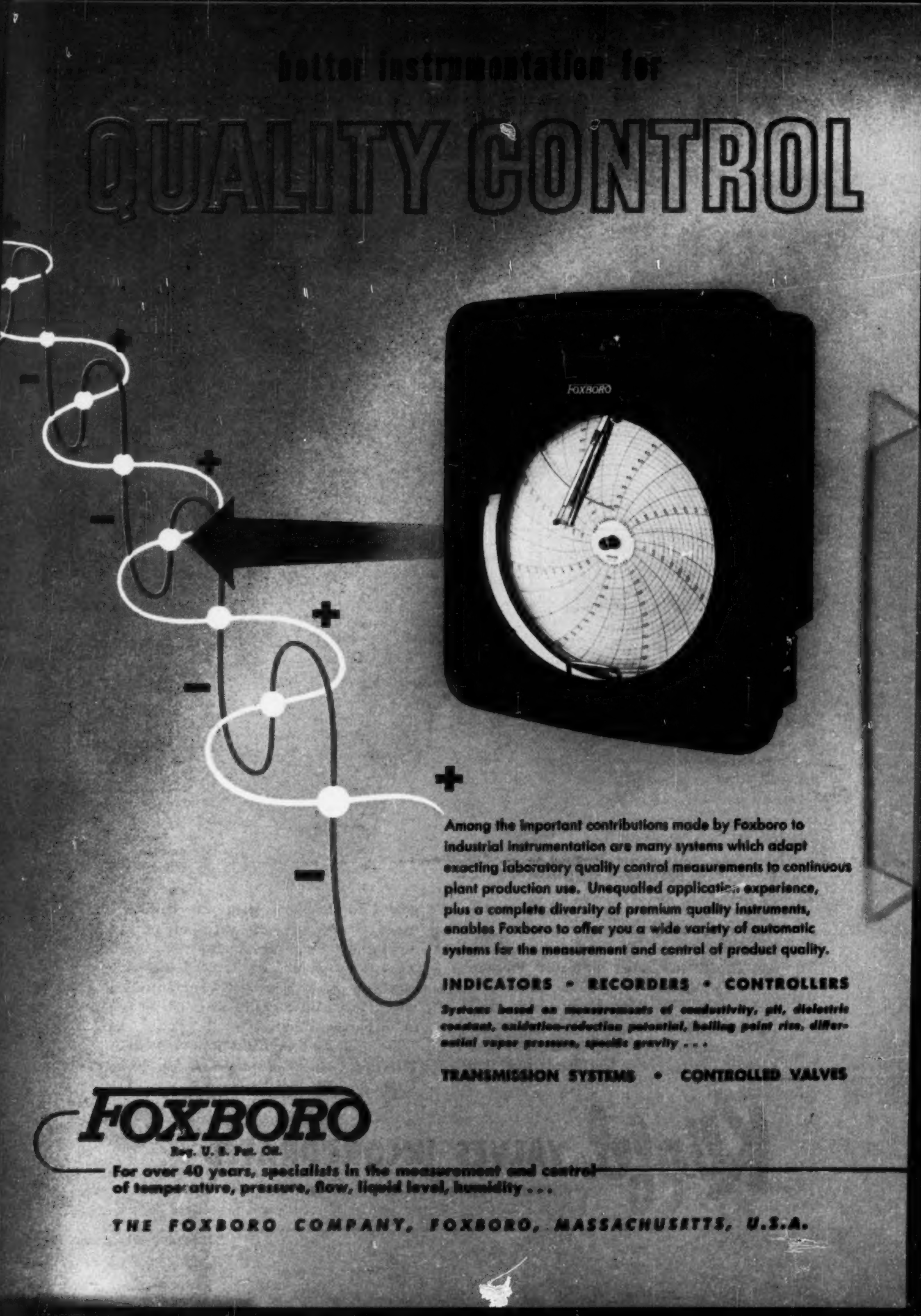
Our engineering and research covers a period of more than twenty (20) years in the production of Oilite metal powder products.

Home office personnel is augmented by a large staff of field engineers located in principal cities of the United States and Canada.

**AMPLEX**

**OILITE PRODUCTS**

**OILITE PRODUCTS INCLUDE** heavy-duty, oil-cushion, self-lubricating, ferrous-base bearings; Oilite bronze* and other nonferrous* bearings; self-lubricating cored* and bar* stock; permanent filters; and friction units.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Among the important contributions made by Foxboro to industrial instrumentation are many systems which adapt exacting laboratory quality control measurements to continuous plant production use. Unequalled application experience, plus a complete diversity of premium quality instruments, enables Foxboro to offer you a wide variety of automatic systems for the measurement and control of product quality.
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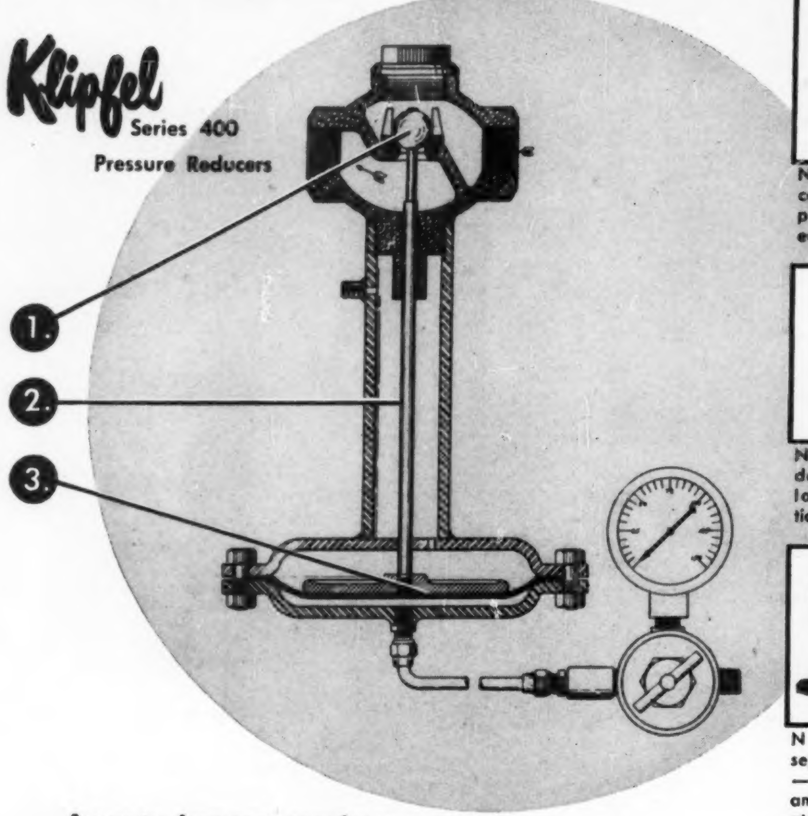
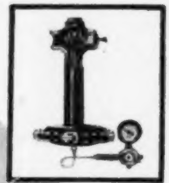
# only 3 moving parts

Klipfel
Series 400
Pressure Reducers



No. 432 with constant air supply—for quick, easy adjustment.

No. 431 with air dome—for isolated installations.

No. 430 with separate air tank—for variable ambient temperature.

**Accurate low-cost regulators . . .**

For longer service with negligible maintenance, operating parts are reduced to just three, inner valve, stem and diaphragm, in the Klipfel 400 Series air-loaded Pressure Reducing Valves. In addition, these 400 Series Valves provide exceptionally close regulation for an unusually low initial cost.

The stainless steel ball inner valve is a perfect sphere, extremely hard and well guided to close to a tight seat. Easily reseated if necessary . . . is self-cleansing and non-sticking. Diaphragm is always in balance . . . no stress, no bursting. Regulation is accurate and easily controlled. For increased safety, flow automatically shuts off in case of diaphragm failure.

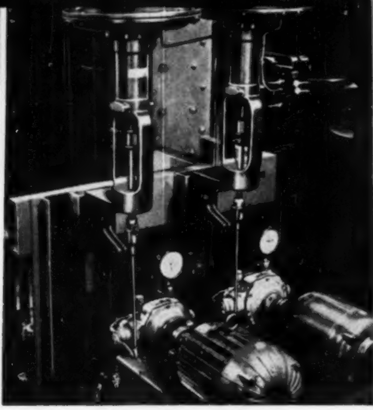
*For full data on the Klipfel 400 Series Valves, for steam, air, water or gas, write Dept.CM-1 for Bulletin No. 148.*

**Klipfel VALVES INCORPORATED**

**DIVISION OF HAMILTON-THOMAS CORP., HAMILTON, OHIO**

"ONE OF THE *Highest Efficiency Units*" IN THE UNITED STATES

View in J. I. Case Co. tractor works at Racine, Wis. Boiler front and Detroit Roto-Grate Stoker on 100,000 lb. per hr. boiler unit.



Two Oilgear Variable Delivery Pumps with simple diaphragm actuated hydraulic servomotor lever controls supply fluid power for the fuel feed and grate drives. An Oilgear drive was experimentally installed on the fuel feed on the first stoker in 1948. On the basis of its performance, Oilgear drives were used for *both* fuel feed and traveling grate on a second stoker unit installed in 1949. Also, Oilgear will replace the mechanical grate drive on the first stoker installed in 1943. Like a shadow, flexible, controllable Oilgear *Fluid* Power causes fuel feed rate and grate speed to accompany steam demand up and down. Recording charts show steam *demand* varies "all over the place," but steam pressure and fuel air ratio stay steady.

# And Oilgear's Range and Control help capture savings hidden in J. I. Case 100,000 lb. Boiler Unit

The 100,000 lb. per hour boiler unit in the J. I. Case Co. tractor works at Racine, Wisconsin, has demonstrated that it is one of the highest efficiency units in the United States. To obtain such high efficiency, careful tests of variable speed drives for fuel feed and grate travel were made during two years. Finally, Case engineers selected Oilgear Fluid Power Drives, for, as Mr. Cole H. Morrow, Chief Plant Engineer says, the Oilgear units proved far superior to electric drives and mechanical transmissions under actual operating conditions.

**SMOOTH, POSITIVE SPEED VARIATION** "In order to obtain high efficiency in any boiler unit," says Mr. Morrow, "*a very precise variable speed fuel feed drive* is required to meet widely varying demand. The Oilgear Drive gives smooth, positive variable speed operation from zero to 100% of capacity with a straight line fuel feed characteristic. This allows us to calibrate the control system for operation within amazingly close limits of fuel-air ratio variation.

**EASE OF CONTROL** "Also, on this type of stoker the grate speed must be infinitely variable from minimum to maximum yet maintained in direct proportion to the rate of fuel feed. Every change in fuel feed requires an immediate and directly proportionate change in grate speed. (Such synchronization) is easily obtained with the Oilgear drive units because of their ease of control, and the simplicity and low force requirements of the control mechanism."

**UNLIMITED SPEED RANGE** Also, fuel feed and grate drives must have a range of speed at least equal to the demand range. Most drives have a range not exceeding 4 to one. Yet at Racine, during the summer, demand drops far below the 25,000 lb. threshold imposed by such a ratio. The Oilgear Drives however have no "ratio" limits, would function down to zero load if necessary. In fact, they give precise load control down to a load of 15,000 pounds per hour normally obtained each day during the summer, and down to as low as 5,000 pph over the weekends still under full automatic control.

**OUTSTANDING RELIABILITY** "One of the outstanding features we discovered . . . was the *reliability of the Oilgear units*. The experimental installation operated almost continuously for a year and a half without any difficulty. This record was far better than we were able to obtain with any other type of drive or transmission."

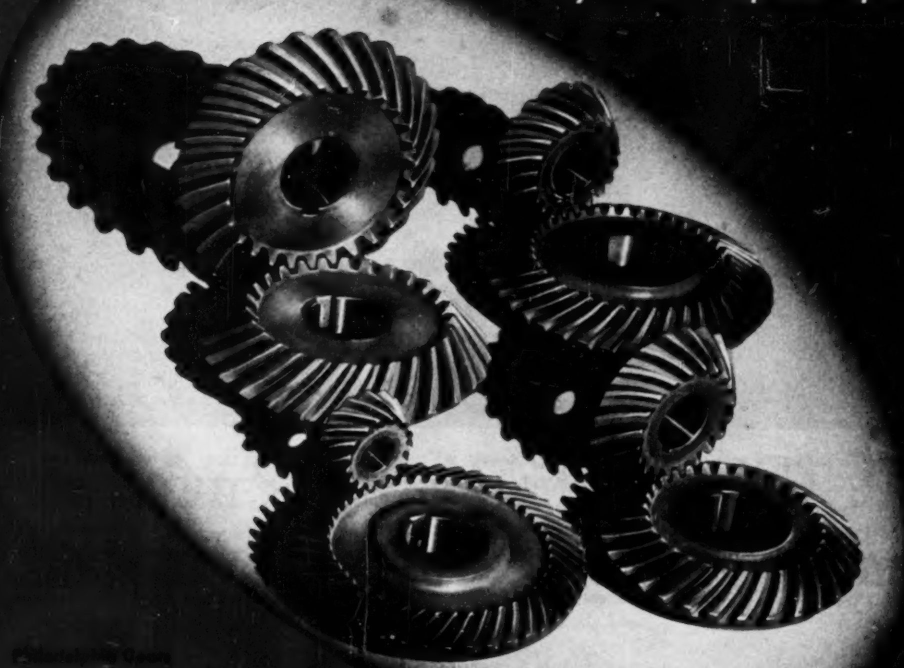
These four features, variability, ease of synchronization and control, actual range from zero fpm, rpm or torque up to maximum, and reliability proven over and over again, are indications of the many advantages Oilgear drives and transmissions offer in machine design and use. Investigate Oilgear equipment as a *better* solution for your problems. THE OILGEAR COMPANY, 1570 West Pierce Street, Milwaukee 4, Wisconsin.

**Oilgear**

**PIONEERS IN FLUID POWER**
**PUMPS, TRANSMISSIONS, CYLINDERS AND VALVES**

# ACCURACY

*you can depend upon*



Philadelphia Gears are cut and [illegible] on modern machines. Our skilled craftsmen employ latest gear making methods to insure accuracy in every phase of production.

Add to this our long experience in making gears of all types, sizes and materials . . . almost 60 years . . . and it is obvious why Philadelphia is your headquarters for thousands of industrial plants.

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Philadelphia Hypoid, Zerol, and Spiral Bevel Gears are available in sizes ranging up to 48 inch diameters. Write on your Business Letterhead for our latest Gear Catalog.


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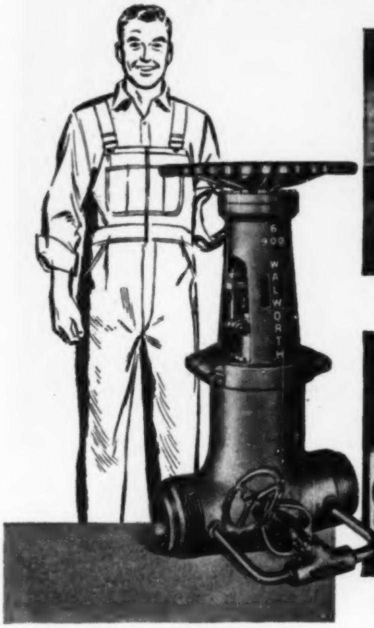
IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

*Industrial Gears and Speed Reducers*
*LimiTorque Valve Controls*

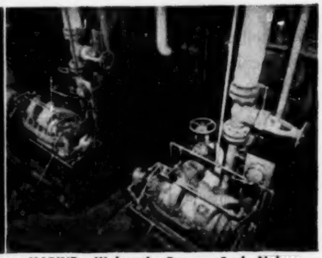
# WALWORTH *Pressure-Seal* VALVES

## For high-pressure, high-temperature services

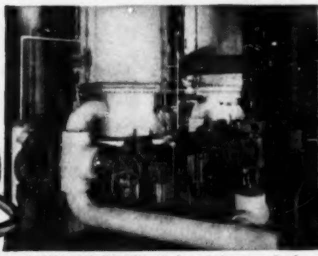



Walworth 6-inch Series 900 Pressure-Seal Gate Valve with Series 1500 Y-type Globe Valve on the by-pass.

CHEMICAL PLANT: Walworth Pressure-Seal Valves in the pressure reducing station of a chemical plant.



MARINE: Walworth Pressure-Seal Valves aboard the S.S. "Wilfred Sykes"—largest Great Lakes ore carrier.



LIGHT AND POWER: Walworth Pressure-Seal Valves equipped with motor operators, in an eastern public utility plant.

PAPER MILL: Fabricated header with 8-inch Series 600 Pressure-Seal Y-Globe Non-Return Valves and Series 600 Pressure-Seal Gate Valve.

The bonnet and body design of Walworth Pressure-Seal Valves is such that the pressure within the valve is used to prevent leakage at the junction of the bonnet and body. The bonnet joint of the Walworth Pressure-Seal Valve is permanently tight because there is no dependency on the ability of any component part of the joint to resist creep during long exposure to high temperature. Sudden temperature and pressure changes do not affect this tightness. Bonnet flanges and studs are eliminated and the weight of the valve is reduced.

An improved flexible disc design maintains seat tightness, even when the valve body is distorted by pipeline stresses or by temperature and pressure changes. This improved disc design makes it easier to open and close this valve.

Walworth Pressure-Seal Valves are easy to disassemble and assemble, and are the most satisfactory valves for high-pressure, high-temperature service. They are available in Series 600, 900, 1500, 2500 and in a wide range of sizes and types. For further information, write for Circular 116.

***SMALL VALVES FOR HIGH PRESSURE-TEMPERATURE SERVICE***

**Series 1500 Cast Steel Y-type Globe and Angle Valves in sizes ¼ to 2 inches.**

# WALWORTH

**valves • fittings • pipe wrenches**

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## TO THE MEMBERS OF——

# THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may affiliate as Associates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

C. E. Davies, Secretary
The American Society of Mechanical Engineers
29 West 39th Street, New York 18, N. Y.

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ME-1-52

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**HERE'S your opportunity to get that for which you have lacked the wherewithal. There's just one catch — you will have to work for it! If you quit easily — don't read any further. Perhaps a little extra work on your thesis will do the trick.**

An engraved certificate signed by the President and Secretary of the Society will accompany each award.

Students should consult the Honorary Chairman regarding the rules for these awards. Only papers by single authors will be considered.

*Each student must submit his paper to the Vice President of the Region in which his Student Branch is located not later than June 1, 1952*

**$150.00**

**For the best paper by an undergraduate on the subject "Engineering as a General Education." This is the Charles T. Main Award.**

**An undergraduate must submit his paper for the Charles T. Main Award or Undergraduate Student Award before thirty days after the completion of his undergraduate work.**

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**For the best paper on an engineering subject by an undergraduate. This is the Undergraduate Student Award.**

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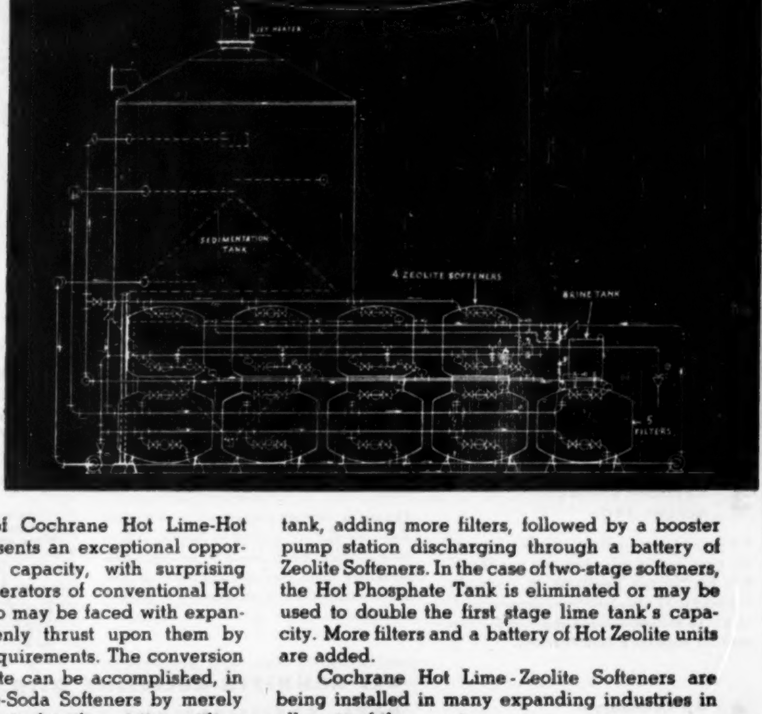
**For the best paper on an engineering subject by a graduate student. This is the Postgraduate Student Award.**

**THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS**

**29 West 39th St., New York 18, N. Y.**

Cochrane
# HOT Lime ZEOLITE
## Water Softener

### A Suggestion for Operators of Hot Lime-Soda and Hot Lime-Soda-Phosphate Softeners




*The installation at the right shows a Cochrane Hot Lime-Zeolite Softener in a paper mill in the Northwest. The Zeolite Softeners are mounted on and supported by the filters in order to save space.*

The introduction of Cochrane Hot Lime-Hot Zeolite Softeners presents an exceptional opportunity for increased capacity, with surprising savings in cost, to operators of conventional Hot Process Softeners who may be faced with expansion problems suddenly thrust upon them by today's production requirements. The conversion to Hot Lime-Hot Zeolite can be accomplished, in the case of Hot Lime-Soda Softeners by merely adding another settling tank to the existing settling tank, adding more filters, followed by a booster pump station discharging through a battery of Zeolite Softeners. In the case of two-stage softeners, the Hot Phosphate Tank is eliminated or may be used to double the first stage lime tank's capacity. More filters and a battery of Hot Zeolite units are added.

Cochrane Hot Lime - Zeolite Softeners are being installed in many expanding industries in all parts of the country.

**COCHRANE CORPORATION • 3142 N. 17th St. • Philadelphia 32, Pa.**

In Canada: Canadian General Electric Co., Ltd., Toronto • In Mexico: Babcock & Wilcox de Mexico, S. A., Mexico City • In Europe: Recuperation Thermique & Epuration, Paris

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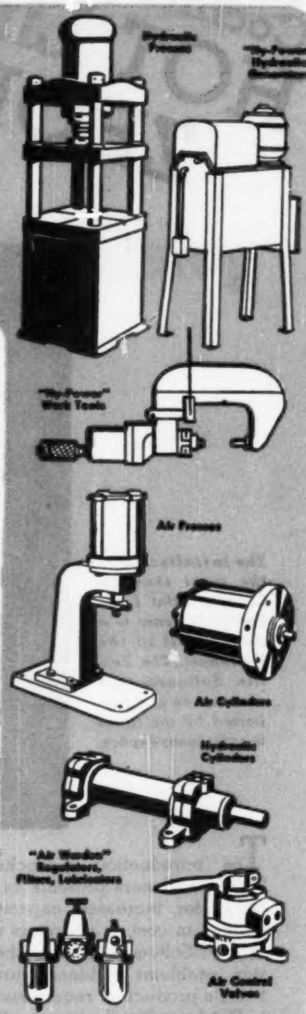
COCHRANE CORPORATION 89 YEARS OF SERVICE 1863 - 1952

# HANNIFIN HELPS EVERY DESIGN AND TOOLING ENGINEER SHOULD HAVE THESE HELPFUL HANNIFIN BULLETINS




**1 Hydraulic Presses—Bulletins 130-34-35**

These Hannifin Catalogs should be a "must" in every machine tool file. Contain complete engineering data and specification tables on 75 standard models of forcing, straightening, forming, bending, and moulding presses. 1 to 150 tons.

**2 "Hy-Power" Hydraulics—Bulletin 150**

Fully explains the high-pressure "Hy-Power" Generator and the many ways it powers "Hy-Power" Work Tools for fast, low-cost riveting, punching, pressing, forming and bending operations. Portable or stationary units in capacities from 5 to 100 tons (more in multiple).

**3 Hydraulic Cylinders—Bulletin 110**

It's easy to get the right cylinder for even the most special job when you use Hannifin's big 52-page handbook on Hydraulic Cylinders. 12 standard bore diameters, 1" to 8". 11 standard mounting styles. More than 65 mounting combinations.

**4 Air Cylinders—Bulletin 210**

A complete catalog on Hannifin Pneumatic Cylinders with a wide range of mounting styles—many combination mountings—12 sizes—any length stroke—1" to 16" bore—plain or cushioned types. Engineering data, design and construction features. A handy reference.

**5 Air Control Valves—Bulletins 57-W, 230-36-40-41**

Hannifin makes all types of control valves for single or double-acting air cylinders. "Packless" rotary disc type. "Effortless" sliding disc type. "Directair" electric disc type. Quick delivery.

**6 Air-Operated Presses—Bulletins 250-51-52**

Hannifin Air-Operated Presses for many assembly operations including staking, punching, press-fitting and light forming, and riveting. 59 different models—½ to 18 tons for bench of floor mounting. Hand, foot or push-button controls.

**7 "Air Warden" Pressure Regulators, Filters, Lubricators—Bulletins 1005-8-9-10**

Pressure Regulators—primary pressures to 150 p.s.i. Reduced pressure—5 to 125 p.s.i. Filters and lubricators—for pressures to 150 p.s.i. Combination units. The finest protection possible for air-operated equipment.

**8 NATION-WIDE HANNIFIN SERVICE**

Hannifin factory-trained field engineers are conveniently located in leading industrial centers. Their practical recommendations will meet your requirements or special specifications. Consultation is part of our service.

**GET HANNIFIN BULLETINS WITH ENGINEERING DATA, SPECIFICATIONS AND DIMENSIONS *Today!***

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
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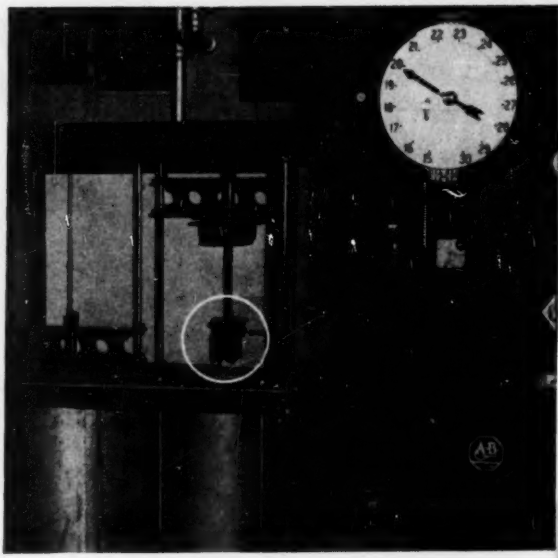
# SCALING RESISTANCE

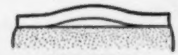
### EVALUATED AT

# HIGH TEMPERATURES

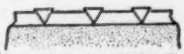


## *High-Temperature Corrosion Often Is the Main Factor in Metal Failure*

*Oxide Scale Breakdown by:*



BLISTERING



SHEAR CRACKING

FLAKING OR SPALLING

Learning why metals fail at high temperatures – determining the actual cause of damage and suggesting as a remedy a more suitable material—these are the jobs of INCO High-Temperature Engineers, who are getting information on such problems for the use of industry.

INCO laboratories in Bayonne, N. J., and Huntington, West Va., have useful data on the properties of metals at elevated temperatures. This information comes from tests made to determine the creep strength, stress-rupture, and other properties of materials at temperatures in some cases up to 2100°F.

Industrial experiences at high temperatures indicate that it is unwise to predict high-temperature performance on the basis of room-temperature properties or short-time high-temperature tests. Other methods have been developed that provide more accurate measures for judging materials.

The machine pictured above was especially designed by INCO Engineers for determining the effect of cyclic heating and cooling on sheet metals while exposed to oxidizing conditions. INCO High-Temperature research likewise covers damage by other corrosive atmospheres. Through work with this and other types of equipment INCO Engineers study the reasons for failure of alloys at high temperatures.

Due to the volume changes accompanying its formation, an oxide film formed at high temperatures on the surface of a metal or alloy is usually under compressive stress. Contraction stresses developed when the underlying metal is cooled further aggravate this situation – and with many alloys may cause rupturing of the normally protective oxide.

Among the factors which influence the resistance to oxidation, the physical characteristics of the formed scale are of importance. The sketches show how these characteristics may cause the breakdown of the scale and thus increase the rate of oxidation.

**Blistering** may occur in oxide layers having good elasticity but poor adherence to the metal surface.

**Shear cracking** on the other hand will be found in oxides that are adherent but relatively brittle.

**Flaking or spalling** results when the oxide is both brittle and non-adherent.

As the scale peels away from the metal, it exposes a fresh area to further attack. A point of importance is that the loss of the oxide causes a progressive loss in metal section—useful load-carrying metal.

In high-temperature applications employing sheet or strip, the necessity of obtaining maximum resistance to this form of destruction by selection of a suitable heat-resisting alloy is of greatest importance.

If high-temperature alloy performance is a problem to you, whether in present activities or in new projects, INCO High-Temperature Engineers will do their best to be of help to you. Let them send you the *High-Temperature Work Sheet*... it is a big aid in explaining your situation fully. Then see if INCO Engineers cannot help solve your difficulty.

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TRADE MARK

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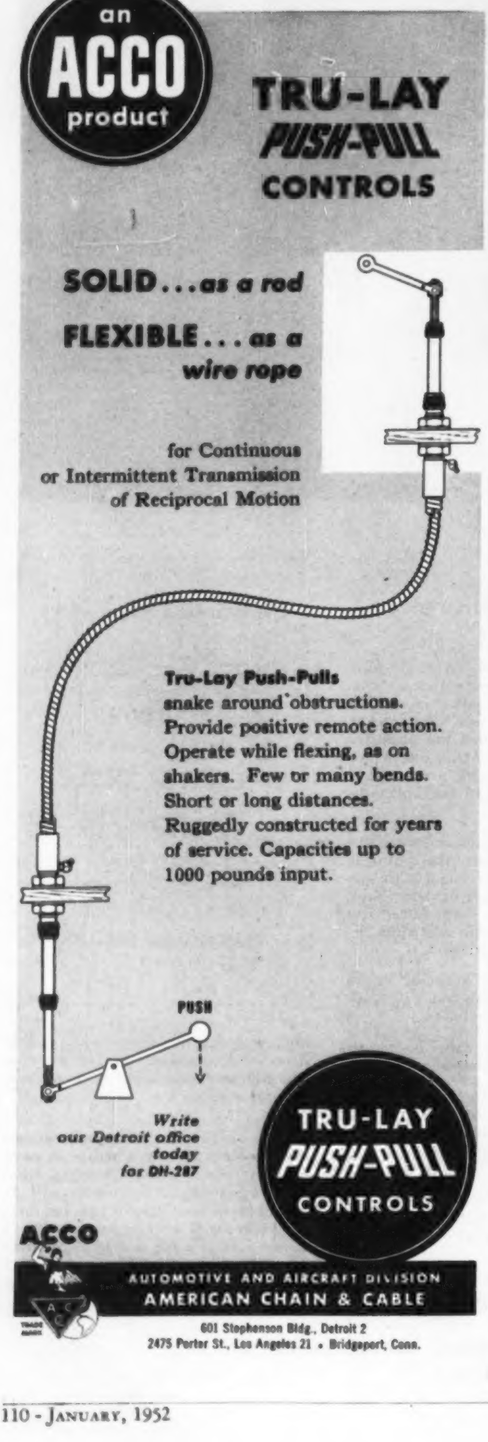
*67 Wall Street, New York 5, N. Y.*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CONTROLS
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MECHANICAL ENGINEERING

December, 1951 — CARD INDEX — Vol. 73, No. 12

# OPPORTUNITIES



*Answers to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.*

## POSITIONS OPEN



**RATES** Classified Advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.70 a line. $1.35 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display Advertisements carried in single column units of multiples of one inch at flat rate of $28 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.



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**EXCELLENT COMPENSATION**

**Send complete resumé for personal interview arranged at your convenience. Box ME 725, 221 W 41 St., NY. 18, NY.**

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Permanent positions with excellent opportunities in New York office for graduate mechanical engineers with two to four years' experience in industrial, chemical or oil refining company. Position will involve diversified activities in the following:

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Submit resumé including education, experience, personal history and salary expected. All applications will be kept confidential and considered promptly.

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*Write complete qualifications.*

Address CA-3640, % "Mechanical Engineering."

**Wanted:** Experienced Power Station Engineer
**Position:** Assistant to Manager of Power Production with administrative responsibility of operating central stations totaling approximately 800,000 kw.
**Location:** Pennsylvania.
**Advancement:** Excellent for growth on job and promotion in near future.
**Experience:** 10 years' minimum, with at least 5 years in operation, maintenance or efficiency work in large modern steam-electric central station. Construction and design experience will be considered.
**Education:** B.S. degree in Mechanical (preferred) or Electrical Engineering from an accredited engineering college.
**Age:** 30–45
Salary commensurate with qualifications.
All applications will be acknowledged. Please send personal record to:
Address CA-3701, % "Mechanical Engineering."

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And because MECHANICAL ENGINEERING represents the most far-reaching endeavors of such men, it has the serious interest of more than 35,000 engineers and executives who know that further industrial growth depends on engineering progress.

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**Recent Engineering College and Technological Graduates**

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Long-range military program offers fine chance for establishing career in aircraft while aiding defense effort. Transportation and established training time paid. Salaries commensurate with experience and ability.

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**Please include summary of education and experience in reply to:**

ENGINEERING PERSONNEL OFFICE

SECTION 4

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Positions now available for highest caliber personnel in the field of airborne automatic electro-mechanical control equipment.

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New and expanding division of an established firm with 20 years of successful experience in the instrument field. Work involved deals with the manufacture and development of highly complex equipment of the most advanced type.

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# PIPING DESIGNER

Excellent salary with considerable premium overtime is offered to a man with heavy experience in oil refinery or chemical plant piping. Duties involve design and layout work plus the coordination of the work of other designers and draftsmen.

Excellent opportunity to assume additional responsibility in an organization established over half a century . . . known throughout the world for leadership in the design and construction of oil refineries and chemical plants. Convenient New York City offices located near all local and commuting transportation facilities.

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**The M. W. KELLOGG Co.**

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# ENGINEERS

**CHANCE VOUGHT AIRCRAFT has openings for qualified men as structural test engineers. Attractive openings for graduate engineers with three to five years' experience in aircraft structures testing. These positions entail a knowledge of structures, aircraft materials and aircraft design.**

**Test engineers will be responsible for major portions of planning and administering structural tests for Naval Aircraft Programs.**

**Permanent positions in long-range projects. Housing readily available in Dallas area.**

***Send resumé to* ENGINEERING PERSONNEL SECTION**

**CHANCE VOUGHT AIRCRAFT DIVISION**
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### TIME AND METHODS ENGINEER

We are looking for a young, high-grade graduate engineer with at least two years' machine shop experience. Will set rates, handle speeds and feeds and must be familiar with up-to-date shop methods and techniques. This is stepping stone for future labor relations assignment. Not a defense position—location, Ohio. Must come to us with a first-class record. In reply state experience, education, and salary desired.

Address CA-3779, care of "Mechanical Engineering."

### MECHANICAL ENGINEERS

We need three young top-grade graduates for our general engineering staff. The work is on product or industrial plant assignments. These men will train for staff positions and must have real ability for development. The Company is known throughout the world for its fine personnel policies. It will pay you to investigate this opportunity stating age, education, and experience.

Address, CA-3780, care of "Mechanical Engineering"

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This laboratory is undertaking fundamental and applied research on the problems of tactical air warfare. You will work with top level research men as well as many senior scientists of the University of Chicago.

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**The University of Chicago**
**Watts S. Humphrey**
*Director of Scientific Personnel*
**6040 South Greenwood Avenue**
**Chicago, Illinois**

## CHIEF MECHANICAL ENGINEER

With advanced degree from accredited engineering college, preferably registered professional engineer, for new chemical plant being established in medium-sized city of Southeastern Ohio by prominent, progressive, well-established pharmaceutical manufacturer.

Must supervise new construction and maintenance of manufacturing buildings, steam generation and distribution of power and water, chemical sewerage collection and treatment. Must be experienced in general machine and welding shop practice. Refrigeration experience desirable. Should have about 10-15 years' experience as plant engineer in chemical industry. Age to 45.

Position is permanent and offers liberal retirement and insurance benefits. Salary $10,000 to $12,000 a year. Please send complete resumé.

**Address CA-3754, c/o "Mechanical Engineering."**

## PHYSICISTS AND SENIOR RESEARCH ENGINEERS

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**Senior Engineers and Physicists having outstanding academic background and experience in the fields of:**

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- Autopilot Design
- Applied Mathematics
- Electronic Subminiaturization
- Instrument Design
- Automatic Production Equipment
- Test Equipment
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- Flight Test Instrumentation

**are offered excellent working conditions and opportunities for advancement in our Aerophysics Laboratory. Salaries are commensurate with ability, experience and background. Send information as to age, education, experience and work preference to:**

**NORTH AMERICAN AVIATION, INC.**
**AEROPHYSICS LABORATORY**

**Box No. H-4**
**12214 South Lakewood Blvd.**
**Downey, California**

## ELECTRICAL AND MECHANICAL ENGINEERS

**WE have attractive opportunities in the design and methods engineering departments in the electric motor field.**

**This is a normal expansion program.**

**Send details of experience and education. Include photo.**

**Address: Chief Engineer**
**Marathon Electric Manufacturing Corporation**
**12th and Cranberry**
**Erie, Pennsylvania**

### MECHANICAL ENGINEER

Recent graduate with outstanding abilities in air liquefaction or allied field for position of President's assistant in established manufacturing organization in this field. Unlimited opportunity for development. Top salary plus profit sharing bonus. Correspondence strictly confidential.

Address CA-3757, care of "Mechanical Engineering."

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A midwestern state University has a MECHANICAL ENGI-ING PROFESSORSHIP available in the field of machine design and/or industrial engineering, an excellent opportunity for one primarily interested in good undergraduate teaching together with some supervision of graduate and other research. Minimum requirements are a Ph.D., an M.S. with several years of industrial experience, or an M.S. wishing to take Ph.D. while drawing full pay. Research and consulting encouraged. Young man preferred. In applying, give rank and salary expected. Address CA-3776, care of "Mechanical Engineering."

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PRODUCTION MANAGER—Small, rapidly growing manufacturer of industrial reinforced plastic, located on Long Island near New York, needs a graduate mechanical engineer with two to three years' production experience; preferably under 30; will have complete responsibility and authority in setting up production line, systems, procedures, etc. Familiarity with tool and die operations, materials field, and mold design desirable. Opportunity unlimited. Salary range $4000 to $5000 per year depending upon qualifications. Please send complete resumé. Address CA-3777, care of "Mechanical Engineering."

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# "OPPORTUNITIES" Section This Month . . . . . 117-124

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## DESIGNERS
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The Aerophysics & Atomic Energy Research Division of North American Aviation, Inc., offers unparalleled opportunities in Research, Development, Design and Test work in the fields of Long Range Guided Missiles, Automatic Flight and Fire Control Equipment and Atomic Energy. Well-qualified engineers, designers and physicists urgently needed for all phases of work in

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**RESEARCH DIVISION**

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**DOWNEY, CALIFORNIA**

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CHIEF MECHANICAL ENGINEER—wanted. Must be experienced in handling design and production of all mechanical requirements of large commercial architect office in Pacific Northwest. Salary open. Address CA-3698, care of "Mechanical Engineering."

ASSISTANT MILL METALLURGIST—for large Copper Company, Chile, South America. Young college graduate with some experience, to work in Mill Metallurgical Laboratory. 3-year contract. Transportation both ways and salary while traveling paid by Company. In reply give complete details. Address CA-3711, care of "Mechanical Engineering."

ASSISTANT HYDRAULIC ENGINEER—with some field experience in construction of hydro-electric power plant projects, etc. for large Copper Company, Chile, South America. Civil Engineering graduate preferred. 3-year contract. Transportation both ways and salary while traveling paid by Company. In reply give complete details. Address CA-3712, care of "Mechanical Engineering."

Midwestern engineering school with enrollment of 1100 students needs instructor or assistant professor with internal combustion engine experience. M.S. degree desired; start February first. Salary open. Address CA-3725, care of "Mechanical Engineering."

RESEARCH ENGINEER—interested in design and testing of special mechanisms; electronic instrument specialists, interested in developing new applications of existing oscilloscopic and oscillographic instruments; technical writers, photo retouchers; if interested in joining a small (200 men) growing organization, should contact Mr. Charles E. Balleisen, Supervisor, Mechanical Laboratory, Southwest Research Institute, 8500 Culebra Road, San Antonio, Texas.

PUMP ENGINEER—To conduct research and development in application of various pump types, also design standard and special purpose models. Practical experience or knowledge in design of low pressure pumps helpful. Should be able to calculate from formula. Recent graduate in Mechanical Engineering with major in hydraulics will be considered. Salary open. Send resumé to Pioneer Pump and Manufacturing Company, 19679 John R. Street, Detroit 3, Michigan.

ENGINEERS—needed in all fields at all levels. Salaries commensurate with experience and ability. Highly confidential service. Bring or mail 3 resumés to: Position Securing Bureau, Inc., (Agency) 45 John St., New York 38, N.Y.

The New York Naval Shipyard urgently needs Naval Architects and engineers in the following fields: Mechanical, Marine, Electrical, Electronics, and Ordnance. The salary for these positions ranges from $3410.00 to $5060.00 per annum, dependent upon the level and length of professional experience of the applicant. Address replies to Employment Division, New York Naval Shipyard, Brooklyn, New York.

ENGINEERS—Expanding southern industry has openings for mechanical engineers for design and machinery development work; experienced electrical engineers and engineer experienced in structural steel and reinforced concrete design. Pulp or paper industry experience helpful but not essential. Please give in first letter full details of education, age, experience, qualifications, references, availability and salary desired. All details confidential. Address CA-3765, care of "Mechanical Engineering."

MAINTENANCE ENGINEERS—Mechanical Graduates with chemical or oil refinery maintenance experience. Knowledge of production problems, plant repairs, alterations, spare parts, inventories, etc. Steady, well-established firm. Pleasant working conditions, insurance, hospitalization, pension plan. Progressive personnel policies. Detroit area. $5,000–$6,400. Address CA-3772, care of "Mechanical Engineering."

LUBRICANTS SALESMAN DESIRED—Nationally known chemical company has opening for salesman to market special line of cutting fluids and drawing compounds. Excellent opportunity for right man with sales experience in lubrication. Drawing account against commission. Car necessary. Write fully your qualifications, on confidence, for early consideration. Address CA-3773, care of "Mechanical Engineering."

PROJECT ENGINEERS—to design a variety of high-speed medium weight automatic machines. Develop new machines and improve existing machines for paper, wood or metal products. Permanent. 5 to 10 years' experience required. The Diamond Match Company, Engineering & Mechanical Development Dept., Barberton, Ohio. Attention: R. C. Brown.

## POSITIONS WANTED

**ROCKET ENGINEER**

Project Engineering—Stress Analysis—Design and Development—Test Facility Design. Address CA-3676, care of "Mechanical Engineering."

CHIEF ENGINEER—20 years' progressive design, construction, and administration. Chemical process, building and equipment fields. Dr. Eng. Sc. Economy programs for product recovery, plant maintenance and utilities. Background: petroleum, food and drug industries. Prefer N. Y. Area. Salary $20,000. Address CA-3746, care of "Mechanical Engineering."

DEVELOPMENT ENGINEER—BSME, age 26. Desires position that involves taking varied work from problem stage thru design, models, testing, patents and preliminary application or production. Experience in chemical research laboratory. Prefer location in Pacific Northwest, consider anywhere. Address CA-3747, care of "Mechanical Engineering."

INDUSTRIAL ENGINEER—30, Chemical, mechanical engineering background. Experienced, manufacturing processes, plant controls, administration, sales engineering. In packaging, machining, chemical industry. Languages: French, German. BSME, BA Chemistry, veteran. Address CA-3761, care of "Mechanical Engineering."

MANAGEMENT or PLANT ENGINEER—37, registered P.E., broad experience research, development, design and production in abrasives, chemical process equipment, tabletting and pelleting equipment, plant layout and cost reduction. Seeks executive level position with bonus or profit sharing participation. Address CA-3762, care of "Mechanical Engineering."

ENGINEERING OR GENERAL MANAGER—Broad administrative experience to guide your product all the way. Ph.D. Applied Mechanics, 12 years' development and design, 10 years' all phases of manufacturing. Business, personnel, sales. Metal and plastic products. Address CA-3769, care of "Mechanical Engineering."

MECHANICAL ENGINEER—Age 37—Experienced plant maintenance and production engineer. 14 years' industrial employment including new plant and facilities layout and construction, equipment and machine design and improvements and administration and supervision of maintenance and operation. Address CA-3771, care of "Mechanical Engineering."

MECHANICAL ENGINEER—35, married, B.S., educated in U. S. and Switzerland, proficient in French and German. Varied experience in the manufacture of small, precision parts, desires supervisory position with manufacturer of instruments or other precision devices. Address CA-3778, care of "Mechanical Engineering."

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## EMPLOYMENT AGENCIES AND SERVICE BUREAUS

EXECUTIVES, ENGINEERS, DESIGNERS, SPECIALISTS—Our staff—technical graduates—serving both employer and applicant 20 years—no fee until placed—Bradley Placement Service, 555 Leader Building—Cleveland 14, Ohio.

ENGINEERS AND EXECUTIVES—This confidential service for outstanding men who desire positions paying $5,000 to $40,000 will develop preliminary negotiations with reputable organizations without risk to present position. For complete details, send experience record and expected salary range. Tomsett Associates, 337 Frick Bldg., Pittsburgh 19, Pa.

SALARIED POSITIONS $3,500 to $35,000. We offer the original personal employment service (established 42 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered; present position protected. Ask for particulars.

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**SALARIED PERSONNEL $3,000—$25,000**

This confidential service, established 1927, is geared to needs of high grade men who seek a change of connection under conditions, assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited.

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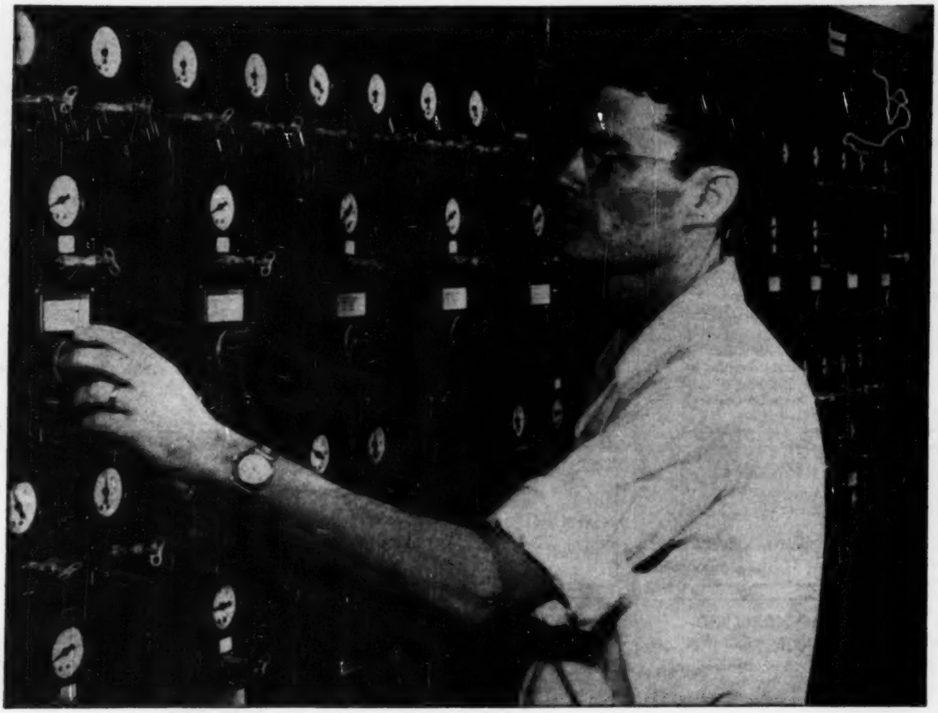

# JUST "*dial in*" YOUR WEATHER!

Above you see the control panel of a "weather factory" for plant research at California Institute of Technology. The weather making is part of the important work being done in Caltech's half-million dollar Earhart Plant Research Laboratory—an imposing layout embracing six air conditioned greenhouses and thirteen air conditioned laboratories, all dedicated to uncovering more basic knowledge of plants and their cultivation.

The plant experiments are being made under the most closely controlled conditions of weather, light, temperature and sterility existing anywhere in the world today. To accomplish this control, the greenhouses are provided with the specially built Minneapolis-Honeywell control panel equipped with Marsh Pressure Gauges, and a time clock panel, constructed by Caltech scientists, for controlling lights. Temperature can be held to a fraction of a degree in any part of the greenhouses and laboratories.

Caltech scientists hope that some of their fundamental research will eventually indicate the best growing conditions for varieties of vegetables increasing the world's food productivity, and may yield vegetables of greatly increased nutritional value.

Here is a project where accuracy of control and operation outweighs all other considerations. So it is particularly significant that all of the pressure gauges on the panel above are Marsh Gauges. A distinguished instrument, Marsh keeps distinguished company. For all plant services and equipment requiring pressure gauges, insist on Marsh.

***Marsh alone has the RECALIBRATOR*** — quickest and best way to correct a gauge or dial thermometer that has been knocked out of adjustment.

**MARSH INSTRUMENT CO.** Sales affiliate of Jas. P. Marsh Corporation
DEPT. 29, Skokie, Ill.
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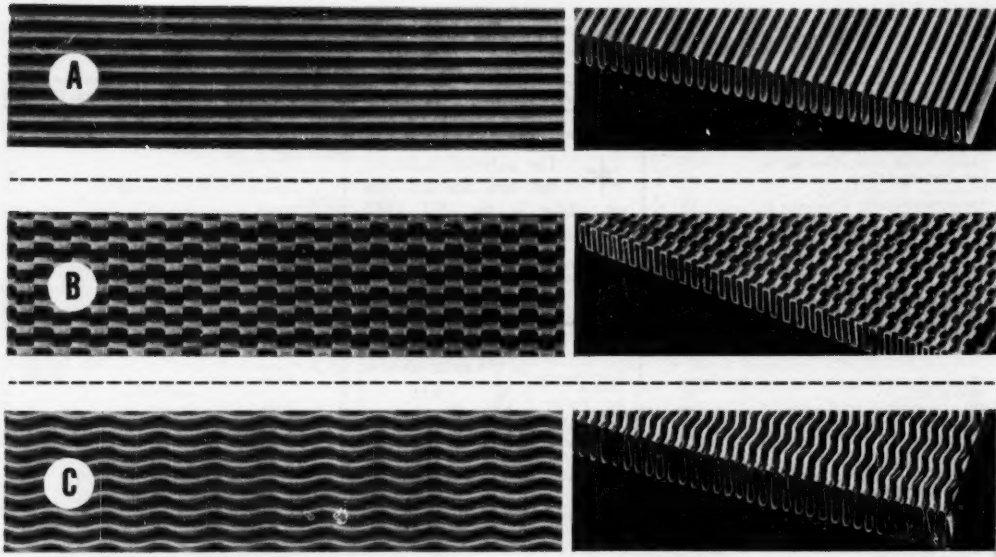



Three of the many types of fin section available.

# TRANE Brazed Aluminum Heat Exchangers Offer Wide Choice of Heat Transfer Surfaces for Greater Design Flexibility

With Trane Brazed Aluminum Heat Exchangers, you choose from a great variety of surfaces in solving exactly your heat transfer problems. They may be straight and continuous (A). They may be serrated (B). Or they can be of herringbone design (C). With these basic designs, exactly the right surface can be selected to provide the correct ratio of heat transfer to pressure drop characteristics.

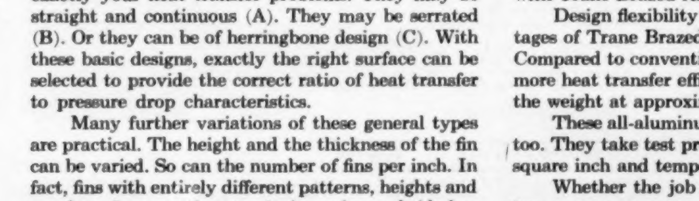
Many further variations of these general types are practical. The height and the thickness of the fin can be varied. So can the number of fins per inch. In fact, fins with entirely different patterns, heights and number of corrugations per inch can be used side-by-side to handle different fluids in the same exchanger.

Thanks to this great flexibility you can provide just the heat transfer, just the pressure drop volume, velocity number and direction of passes you want with Trane Brazed Aluminum Heat Exchangers.

Design flexibility is but one of the many advantages of Trane Brazed Aluminum Heat Exchangers. Compared to conventional exchangers, they produce more heat transfer efficiency in ¼ the space with ⅓ the weight at approximately ½ the cost.

These all-aluminum heat exchangers are rugged, too. They take test pressures up to 1,000 pounds per square inch and temperatures from –300° to 500° F.

Whether the job calls for high or low temperatures or pressures, one stream or many, Trane Brazed Aluminum Heat Exchangers can be the answer. Contact your Trane sales office or write direct.



Here are a few of the many varieties of Trane Brazed Aluminum Heat Exchangers which are now in actual service: 1) A cross flow unit for liquid-to-gas exchange used for condensing purposes. 2) A cross flow gas-to-gas unit which is used for intercooling for aircraft engines. 3) A counter flow liquid-to-liquid exchanger for high pressure application.

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**KEEP INFORMED—Pages 41-64** | **JANUARY, 1952** | **OPPORTUNITIES—(classified ads) Pages 117-124**



***** **The asterisk indicates that firm also has product catalog in the 1952 ASME Mechanical Catalog and Directory**

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**CONSULTING SERVICE . . . Page 126**



**MECHANICAL ENGINEERING, 29 W. 39th St., New York 18, N. Y.**

Additional information is requested on the following advertisements in the January 1952 issue

| Page No. | Name of Advertiser |
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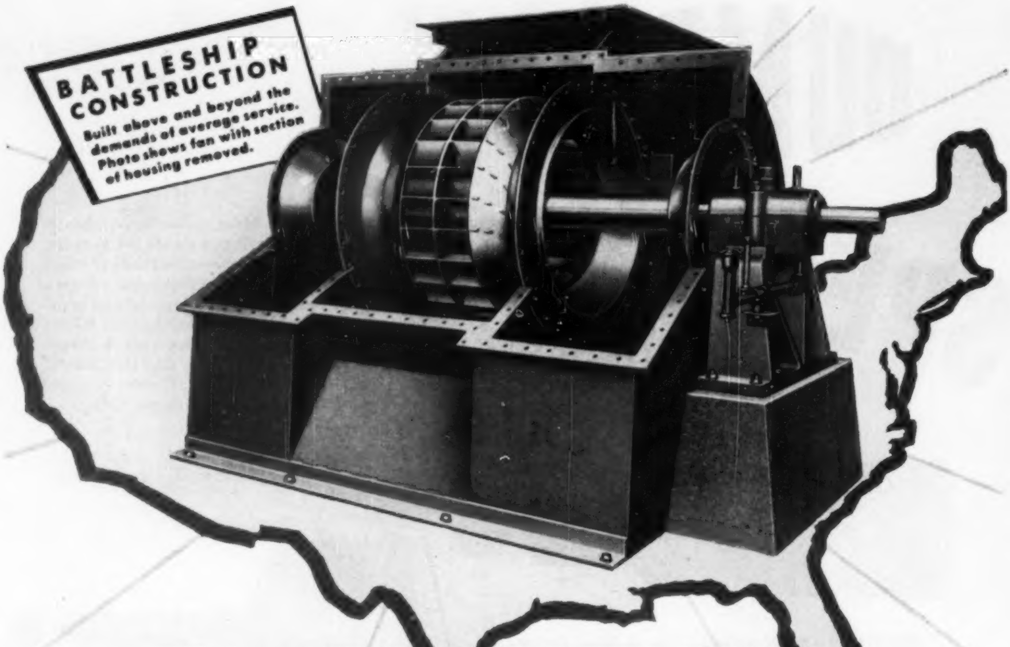


# *These HEAVY-DUTY FANS*

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**Wide popularity — and deserved!** Clarage Type RT Fans bring efficient performance and tremendous endurance to your **most exacting** jobs — induced draft, forced draft, and furnishing air for industrial processes . . . pressures to 38.6 inches (standard air); temperatures to 1000 deg. F.; capacities to 300,000 c. f. m.

Here is **HEAVY-DUTY fan equipment** which carries the endorsement of consulting engineers, plant engineers and boiler manufacturers. Install RT Fans and your first cost is the last — for a **long time** to come. Call us in for specific recommendations!

**YOU CAN RELY ON**

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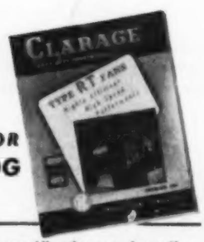



**Applications, specifications and available arrangements all covered in catalog. Send for your copy today.**

**Clarage Fan Company** 609 PORTER STREET **KALAMAZOO, MICH.**

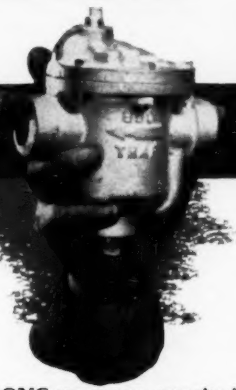
*SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES*

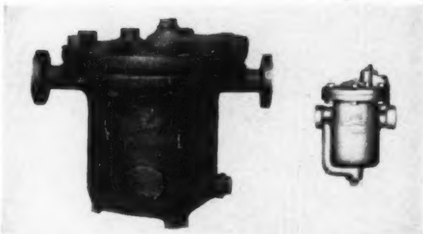
**IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal**

# FOR BIG TRAP CAPACITY IN A SMALL PACKAGE

## ...buy Armstrongs

*SIZE FOR SIZE THEY GIVE YOU MORE*





***FROM THE RIDICULOUS TO THE SUBLIME . . .*** The monstrosity on the left is a steam trap once manufactured in Germany. It weighs 116 lbs. but has no more capacity than the 10½ lb. Armstrong trap on the right. All of which is a means of focussing your attention on the importance of a steam trap leverage system. The size of the big trap is necessary due to its crude-by-comparison leverage design.

ARMSTRONG steam trap capacity is a bargain size for size because of the patented leverage system. In an Armstrong trap for 100 psig, leverage is higher than in one for, say, 15 psig. Thus, a larger valve can be opened than would be possible if the leverage was the same for all pressures.

That sounds simple, but isn't. If higher leverage is secured with a longer lever arm, a bigger trap body is needed. That's the trouble with the elephant shown at the left. Also the design must permit the valve to open *wide* or it will restrict the orifice, reducing capacity. *Armstrong's design answers these problems better than any other design.*

P. S. When comparing traps be sure capacities are based (as are Armstrongs) on *actual* tests with condensate at steam temperature. No other basis is reliable. ARMSTRONG MACHINE WORKS, 894 Maple St., Three Rivers, Michigan.

SEE OUR CATALOG IN SWEET'S

**The 36-PAGE STEAM TRAP BOOK** gives dimensions, weights and actual capacities of Armstrong traps. Write for a copy or Call your local Armstrong Representative.


# ARMSTRONG STEAM TRAPS